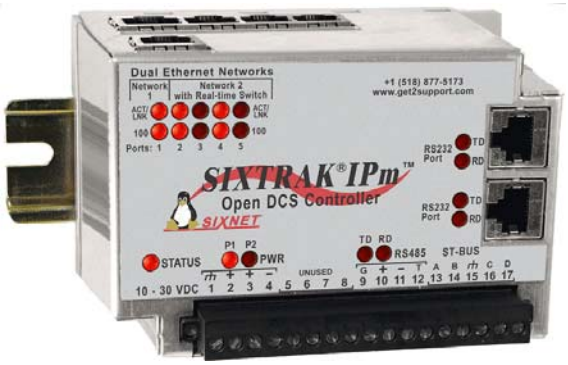
SIXNET

SIXNET IPm
IEC-60870-5
Slave Protocol Driver
User's Manual



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3. Document Revision History

Date	Rev	Who	Description of the Change
09/15/04	0	GMS	First preliminary draft. Circulated around SIXNET for comments and approval.
12/11/06	1	SAS	Approved for implementation.
04/20/07	2	GMS	Updated after a second detailed review of IEC-60850-5 specification documents and to include object mapping design strategy and tables, configuration tool requirements / specifications and sample INI file sections
06/16/07	3	GMS	Updated after implementation of the first release of the run-time driver (IPm part) to SIXNET. (driver version 2.0.0).

4. Introduction

The purpose of this document is to describe the preliminary specifications of the IEC-60870-5-101/104 Slave Protocol Driver for the SIXNET IPm family of open controllers and RTUs

The IEC-60870-5-101/104 slave driver for SIXTRAK and VERSATRAK IPm controllers implements a SLAVE device function. It has been designed to enable data exchange with all types of I/O within the IPm devices and to obtain the maximum advantage of IPm features while providing full compliance with IEC-60870-5-101/104 standards.

The IEC-60870-5-101/1-4 slave is highly configurable. It includes a Windows configuration utility, which integrates into the SIXNET I/O Tool Kit. The configuration utility is callable from the "Tools Menu" of the SIXNET I/O Tool Kit and enables the user to completely define and customize the run-time behavior of the slave driver.

The SIXNET IPm Slave protocol driver implements the following IEC-60870-5 standard parts:

- IEC 60870-5-101: Basic telecontrol tasks
- IEC 60870-5-104: TCP/IP Network access for IEC 60870-5-101

The IEC 60870-5-101/104 protocol provides a standardized way to communicate with other systems. IEC 60870-5-101/104 provides a communication profile for sending basic telecontrol messages between two systems, which uses permanent, directly connected data circuits between them. The IEC Technical Committee 57 (Working Group 03) have developed a protocol standard for Telecontrol, Teleprotection, and associated telecommunications for electric power systems. The result of this work is IEC 60870-5. Five documents specify the base IEC 60870-5. The documents are:

- IEC 60870-5-1 Transmission Frame Formats
- IEC 60870-5-2 Data Link Transmission Services
- IEC 60870-5-3 General Structure of Application Data
- IEC 60870-5-4 Definition and coding of Information Elements
- IEC 60870-5-5 Basic Application Functions

The IEC Technical Committee 57 has also generated two companion standards IEC 60870-5-101 and IEC 60870-5-104 especially oriented for basic telecontrol tasks applications. The IEC 60870-5-101/104 standards are based on the five documents IEC 60870-5-1 to 5. The IEC-60870-5-101/104 Slave protocol for SIXNET-IPm make IPm devices behave like an IEC-60870-5-101 outstation and uses V24/RS-232 communication lines, which can be connected directly to the Master Unit or to a communication channel. Also, networking support over Ethernet-TCP/IP as specified by IEC-60870-5-104 standard is supported.

The IEC-60870-5-101/104 slave protocol driver for SIXNET-IPm allows an IEC-60870-5-101/104 master station to retrieve data and send commands to the IPm devices. In unbalanced transmission mode the master station is always the initiator, i.e. the slave station can only send data if requested to do so. SIXNET-IPm implementation of the IEC-60870-5-101/104 slave protocol supports subsets of the ASDUs in both control direction and monitoring direction. The following sections of this document describe the protocol implementation and the interoperability and conformity to the IEC specification.

5. SIXNET IPm IEC-60870-101/104 Implementation

The SIXNET IPm IEC-60870-5 slave driver package consist of three parts or modules:

- The LINUX based Run-Time IEC-60870-5-101/104 driver module running within the IPm devices
- The Microsoft Windows based Configuration Add-on program
- The Microsoft Windows based on-line help documentation system

The Run-Time SIXNET IPm IEC-60870-5-101/104 slave driver module allows the SIXNET IPm devices to respond to data read and write commands issued by a master unit connected to the IPm either on the serial ports or on the TCP/IP network. The driver maps the SIXNET IPm Internal I/O Database to specific IEC-60870-101 data objects thus making the IPm I/O database values available to IEC-60870-5-101/104 masters in both monitoring (READ) and Command (WRITE) modes. The slave driver module has been developed in GNU-C.

The Run-Time SIXNET IPm IEC-60870-5-101/104 slave driver is configurable by the means of a Microsoft Windows based configuration add-on tool, which is integrated to the SIXNET I/O Tool Kit via the SIXNET's sxaddon.dll library. Using the configuration tool, the user has the ability to configure the following:

- Mapping of Supported IEC-60870-5-101 data objects to SIXNET IPm database I/O registers
- Communication mode: Serial Port based (IEC-60870-5-101) or TCP-UDP/IP based (IEC-60870-5-104)
- Communications parameters (Baud rate, timeouts TCP port , etc)

The communications between the Configuration Add-On and the Run-Time module is done via an ASCII text file generated and maintained by the Configuration Add-On, and downloadable to the IPm stations by the means of the "User Files download" function of the SIXNET I/O Tool Kit.

The configuration Add-On program makes use of all current sxaddon.dll functions in order to automate as long as possible the configuration process. In particular, the configuration add-on perform the following functions:

- Read the list of IPm stations defined in the current project.
- Maintain an ASCII configuration file for every station that has an IEC-60870-5-101/104 driver installed and configured.
- Maintain a master ASCII configuration file for the whole SIXNET I/O Tool Kit project.
- Allow the user to select a particular station from the project station list and to define its IEC-60870-5-101/104 slave driver configuration.
- Allow the user to define the number of IEC-60870-5-101 data points for each of the supported IEC-60870-5-101 data types and their mappings to SIXNET Registers (IEC-60870-5 database sizing and mapping)
- Read the Tag List of the selected station and allow the user to define the SIXNET I/O to IEC-60870-5-101/104 object mappings and IEC-60870-5 monitoring group coding.
- Define the behavior of the run-time slave driver.
- Define the run-time slave driver communications mode (IEC-608070-5-101 or 104) and parameters.
- Automatically update the Communication Port Settings assignments in the SIXNET Tool Kit station's configuration.
- Update the "Files to Load" property of the station's SIXNET I/O Tool Kit configuration in order to include the station's IEC-60870-5 slave driver configuration INI file in the station's files to load list.

5.1 IPm IEC-60870-5 Slave Driver Implementation Table

The following table identifies the IEC-60870-5-101/104 data types that are be supported by the SIXNET IPm IEC-60 870-5-101/104 slave p rotocol inte rface in both monitor (read) an d com mand (write) messages. T he definition and ma pping of SIXNET I/ O databa se variables into spe cific IEC-608 070-5-101/104 data types is configurable.

Note: Values in (…) are references to IEC-60870-5-101 standard document

TYPE ID	TYPE	DESCRIPTION	DATA REPRESENTATION	CORRESPONDING (MAPPABLE) SIXNET I/O TYPE AND ACCESS DIRECTION
1	M_SP_NA_1 (7.3.1.1)	Monitored Single-point Information. This data type is used to store a single binary input point. Associated time-tagged event information for this type are M_SP_TA_1 (2) and M_SP_TB_1 (30)	Single bit value (7.2.6.1) with: 0=Off and 1=On.	DI (READ)
3	M_DP_NA_1 (7.3.1.3)	Monitored Dual-point Information. This data type is used to store a dual-point binary input value (i.e., valve status). Associated time-tagged event information for this type are M_DP_TA_1 (4) and M_DP_TB_1 (31).	Dual-bit status (7.2.6.2) with: 00b (0 decimal) = indeterminate or intermediate, 01b (1 decimal) = Off, 10b (2 decimal) = On and 11b (3 decimal) = indeterminate.	DI (READ)
5	M_ST_NA_1 (7.3.1.5)	Monitored Step-point Information. This data type is used for step position of transformers or other step position information. The value for the position ranges from -64 to 63. Associated time-tagged event information for this type are M_ST_TA_1 (6) and M_ST_TB_1 (32).	Step data (7.2.6.5) is stored in a single character value with bits 0-6 (-64 to +63) representing the step position and bit 7 representing the following states: 0 = Equipment is not in transient state 1 = Equipment in transient state.	DI (Transient state) + AI (Step position) Or DI (Transient and position states) (READ)
9	M_ME_NA_1 (7.3.1.9)	Monitored Normalized Measured Value. This data type is used for analog input data. Associated time-tagged event information for this type are M_ME_TA_1 (10) and M_ME_TD_1 (34).	Normalized values (7.2.6.6) are stored in a word (16-bit) data area with a range of -1..+1-2-15	AI AO (READ)

TYPE ID	TYPE	DESCRIPTION	DATA REPRESENTATION	CORRESPONDING (MAPPABLE) SIXNET I/O TYPE AND ACCESS DIRECTION
11	M_ME_NB_1 (7.3.1.11)	Monitored Scaled Measured Value. This data type is used for analog input data. Associated time-tagged event information for this type are M_ME_TB_1 (12) and M_ME_TE_1 (35).	Scaled values (7.2.6.7) are stored in a word (16-bit) data area with a range of -2^{15} .. $+2^{15}-1$	AI AO (READ)
13	M_ME_NC_1 (7.3.1.13)	Monitored Measured value, short floating point number. This data type is used for analog input data. Associated time-tagged event information for this type are M_ME_TC_1 (14) and M_ME_TF_1 (36).	Short floating point number (7.2.6.9) are stored in a double-word (32-bit) data area in IEEE STD 754 format	FI FO (READ)
15	M_IT_NA_1 (7.3.1.15)	Monitored Integrated Total-point Information. This data type is used to store meter or other count data. Associated time-tagged event information for this type are M_IT_TA_1 (16) and M_IT_TB_1 (37).	Binary counter data (7.2.6.9) is stored in a double-word (32-bit) value with a range of -2^{31} ..$+2^{31}-1$.	LI (READ)
21	M_ME_ND_1 (7.3.1.21)	Monitored Normalized Measured Value without quality descriptor. This data type is used for analog input data.	Normalized values (7.2.6.6) are stored in a word (16-bit) data area with a range of -1..+1-2-15	AI AO (READ)
45	C_SC_NA_1 (7.3.2.1)	Single-point Command This command is used to control a single binary point such as a relay.	Single bit value (7.2.6.15) With 0 = Off and 1 = On	DO (WRITE)
46	C_DC_NA_1 (7.3.2.2)	Double-point Command. This command is used to control a dual-point binary control device such as a trip/close relay.	Double Command (7.2.6.16) with 0 = Not permitted 1 = Off 2 = On 3 = Not permitted	DO (WRITE)
47	C_RC_NA_1 (7.3.2.3)	Regulating Step Command This command is used to control a stepping device such as a transformer.	Regulating Step Command (7.2.6.17) with 0 = Not permitted 1 = Next step lower 2 = Next step higher 3 = Not permitted	DO (WRITE)

TYPE ID	TYPE	DESCRIPTION	DATA REPRESENTATION	CORRESPONDING (MAPPABLE) SIXNET I/O TYPE AND ACCESS DIRECTION
48	C_SE_NA_1 (7.3.2.4)	Setpoint Command, Normalized Value. This command is used to control an analog device.	Normalized values (7.2.6.6) are stored in a word (16-bit) data area with a range of $-1..+1-2^{-15}$	AO (WRITE)
49	C_SE_NB_1 (7.3.2.5)	Setpoint Command, Scaled Value. This command is used to control an analog device.	Scaled values (7.2.6.7) are stored in a word (16-bit) data area with a range of $-2^{15} .. +2^{15}-1$	AO (WRITE)
50	C_SE_NC_1 (7.3.2.6)	Setpoint Command, Short Float Value This command is used to control an analog device or computation.	Short floats (7.2.6.8) are stored in a double-word (32-bit) data area in IEEE STD 754 format.	FO (WRITE)

Table 1 Supported IEC-60870-5 data types

5.2 SIXNET I/O to IEC-60870-5 Point Mappings

5.2.1 General

Every I/O register within the IPm I/O Database can be mapped into supported IEC-60870-5 data types as described in Table 1

Due to the high amount of I/O registers available within the IPm database (and therefore the high amount of IEC-60870-5 data points that can be made available to master devices), response messages to master group read requests can become very large in size. In order to limit the size of response messages, the user is given the ability to limit, per IEC-60870-5 data type, the number of points availabl e in the IEC-60870-5 virtual database. This feature is configurable in the SIXNET I/O Tool Kit using the SIXNET IPm IEC-60870-5 Slave Driver configuration add-on.

5.2.2 Supported IEC-60870-5-101/104 Object Types

The SIXNET IPm IEC-60 870-5-101/104 Slave Driver supports the follo wing I EC-60870-5-101/104 d ata types:

- Single Points (1-bit discrete I/O), Monitor (READ) and Control (WRITE)
- Double Points (2-bit, 4 state discrete I/O), Monitor (READ) and Control (WRITE)
- Step positio n informatio n (128 -state enco ded variabl es I/O), Monitor (READ) and Control (WRITE)
- Measured Va lues (No rmalized o r Scale d or Fl oating Point analog I/O values) Monitor (REA D) and Control (WRITE)
- Integrated Values (32-bit counters) Monitor (READ)

Any of these data types can be requested, in the monitor direction, with or without time tag information

Every SIXNET IPm I/O po int within the IPm Databa se can be m apped into o ne IEC-6 0870-5-101/104 point address as described in Table 1

Every SIXNET IPm st ation running the IEC-6 0870-5-101/104 slave protocol driver maintain a database containing one block of a configur able number of contiguous IEC-60870-5-101/104 points for every IEC-60870-5-101/104 d ata type su pported by the drive r (s ee Ta ble 1). Each on e of these blocks will be mapped into a corresponding block of contiguous SIXNET registers of a compatible type (see Ta ble 1). The SIXNET point addre ss of the first point in eac h map ped block is confi gurable. Any SIXNET I/O variable that has a tag or a module assigned can be mapped into any IEC-6 0870-5 point as long as the involved IEC-60870-5-101/104 point and the corresponding SIXNET I/O regi ster are type-compatible as specified in Table 1

The IEC-60870-5-101/104 Information Object Address (IOA) range of the objects in eve ry mapped IEC block is fixed and unique, as shown in Table 3

The SIXNET IPm IEC-60 870-5-101/015 drive r supports monito ring of sup ported IEC-60870-5-101/104 monitoring object types either without time tag, with regular time tag or with CP56 time tag.

The maximu m numbe r of distinct I/O obje cts in each type that can be configured and m apped into SIXNET I/O points de pends on th e le ngth of th e I nformation O bject Ad dress -which can in tu rn be configured to be 1, 2 or 3 o ctets l ong- the si ze of the SIXNET I/O datab ase for the corresponding SIXNET I/O type and th e fact that the I EC-60870-5-101/104 information obj ect address m ust be u nique across all supported IEC-68070-5-101/104 object types.

The following tables show the maximum numbe r of in formation o bjects that can be defined for ea ch of the sup ported IEC type s and th e info rmation o bjects a ddress range th at ca n be m apped into SIXNET registers as a function of the Information Object Address length:

Length of the Information Address Field (octets)	Maximum number of unique IEC-60870-5-101 information elements per type
1 8	
2 1024*	
3 1024*	

Table 2 Maximum number of information objects

*** Can't exceed the size of the IPm I/O database**.

TYPE (IEC-60870-5-101 Paragraph) (Type ID)	DESCRIPTION	DATA REPRESENTA-TION	INFORMATION OBJECT ADDRESS RANGE (IN HEXADECIMAL FORMAT)		
			1-Octet IOA	2-Octet IOA	3-Octet IOA
M_SP_NA_1 (7.3.1.1) (1)	Monitored Single-point Information. This data type is used to store a single binary input point. Associated time-tagged event information for this type are M_SP_TA_1 (2) and M_SP_TB_1 (30)	Single bit value (7.2.6.1) with: 0=Off and 1=On.	0x00-0x07	0x0000-0x03FF	0x000000-0x0003FF
M_DP_NA_1 (7.3.1.3) (3)	Monitored Dual-point Information. This data type is used to store a dual-point binary input value (i.e., valve status). Associated time-tagged event information for this type are M_DP_TA_1 (4) and M_DP_TB_1 (31).	Dual-bit status (7.2.6.2) with: 00b (0 decimal) = indeterminate or intermediate, 01b (1 decimal) = Off, 10b (2 decimal) = On and 11b (3 decimal) = indeterminate.	0x08-0x0F	0x0400-0x07FF	0x000400-0x0007FF
M_ST_NA_1 (7.3.1.5) (5)	Monitored Step-point Information. This data type is used for step position of transformers or other step position information. The value for the position ranges from -64 to 63. Associated time-tagged event information for this type are M_ST_TA_1 (6) and M_ST_TB_1 (32).	Step data (7.2.6.5) is stored in a single character value with bits 0-6 (-64 to +63) representing the step position and bit 7 representing the following states: 0 = Equipment is not in transient state 1 = Equipment in transient state.	0x10-0x17	0x0800-0x0BFF	0x000800-0x000BFF

TYPE (IEC-60870-5-101 Paragraph) (Type ID)	DESCRIPTION	DATA REPRESENTA-TION	INFORMATION OBJECT ADDRESS RANGE (IN HEXADECIMAL FORMAT)		
			1-Octet IOA	2-Octet IOA	3-Octet IOA
M_ME_NA_1 (7.3.1.9) (9)	Monitored Normalized Measured Value. This data type is used for analog input data. Associated time-tagged event information for this type are M_ME_TA_1 (10) and M_ME_TD_1 (34).	Normalized values (7.2.6.6) are stored in a word (16-bit) data area with a range of -1..+1-2-15	0x18-0x1F 0x20-0x27(P1) 0x28-0x2F(M1) 0x30-0x37(M2) 0x38-0x3F(M3)	0x0C00-0x0FFF 0x1000-0x03FF (P1) 0x1400-0x17FF (M1) 0x1800-0x1BFF (M2) 0x1C00 0x1FFF (M3)	0x000C00-0x000FFF 0x001000-0x0003FF (P1) 0x001400-0x0017FF (M1) 0x001800-0x001BFF (M2) 0x001C00 0x001FFF (M3)
M_ME_NB_1 (7.3.1.11) (11)	Monitored Scaled Measured Value. This data type is used for analog input data. Associated time-tagged event information for this type are M_ME_TB_1 (12) and M_ME_TE_1 (35).	Scaled values (7.2.6.7) are stored in a word (16-bit) data area with a range of -2^{15} .. $+2^{15}-1$	0x40-0x47 0x48-0x4F(P1) 0x50-0x57(M1) 0x58-0x5F(M2) 0x60-0x67(M3)	0x2000-0x23FF 0x2400-0x27FF (P1) 0x2800-0x2BFF(M1) 0x2C00-0x2FFF(M2) 0x3000-0x33FF(M3)	0x002000-0x0023FF 0x002400-0x0027FF (P1) 0x002800-0x002BFF(M1) 0x002C00-0x002FFF(M2) 0x003000-0x0033FF(M3)
M_ME_NC_1 (7.3.1.13) (13)	Monitored Measured value, short floating point number. This data type is used for analog input data. Associated time-tagged event information for this type are M_ME_TC_1 (14) and M_ME_TF_1 (36).	Short floating point number (7.2.6.9) are stored in a double-word (32-bit) data area in IEEE STD 754 format	0x68-0x6F 0x70-0x77(P1) 0x78-0x7F(M1) 0x80-0x87(M2) 0x88-0x8F(M3)	0x3400-0x37FF 0x3800-0x3BFF(P1) 0x3C00-0x3FFF(M1) 0x4000-0x43FF(M1) 0x4400-0x47FF(M3)	0x003400-0x0037FF 0x003800-0x003BFF(P1) 0x003C00-0x003FFF(M1) 0x004000-0x0043FF(M1) 0x004400-0x0047FF(M3)

TYPE (IEC-60870-5-101 Paragraph) (Type ID)	DESCRIPTION	DATA REPRESENTATION	INFORMATION OBJECT ADDRESS RANGE (IN HEXADECIMAL FORMAT)		
			1-Octet IOA	2-Octet IOA	3-Octet IOA
M_IT_NA_1 (7.3.1.15) (15)	Monitored Integrated Total-point Information. This data type is used to store meter or other count data. Associated time-tagged event information for this type are M_IT_TA_1 (16) and M_IT_TB_1 (37).	Binary counter data (7.2.6.9) is stored in a double-word (32-bit) value with a range of $-2^{31}..+2^{31}-1$.	0x90-0x97	0x4800-0x4BFF	0x004800-0x004BFF
M_ME_ND_1 (7.3.1.21) (21)	Monitored Normalized Measured Value without quality descriptor. This data type is used for analog input data.	Normalized values (7.2.6.6) are stored in a word (16-bit) data area with a range of -1..+1-2-15	0x18-0x1F	0x0C00-0x0FFF	0x000C00-0x000FFF
C_SC_NA_1 (IEC 60870-5-101: 7.3.2.1) (45) C_SC_TA_1 (IEC 60870-5-104: 8.1) (58)	Single-point Command (-101) and Single point command with time tag (-104): This command is used to control a single binary point such as a relay.	Single bit value (7.2.6.15) With 0 = Off and 1 = On	0x98-0x9F (C) 0xA0-0xA7 (M)	0x4C00-0x4FFF (C) 0x5000-0x53FF (M)	0x004C00-0x004FFF (C) 0x005000-0x0053FF (M)
C_DC_NA_1 (IEC 60870-5-101: 7.3.2.2) (46) C_DC_TA_1 (IEC 60870-5-104: 8.2) (59)	Double-point Command (-101) and. Double-point Command with time tag (-104): This command is used to control a dual-point binary control device such as a trip/close relay.	Double Command (7.2.6.16) with 0 = Not permitted 1 = Off 2 = On 3 = Not permitted	0xA8-0xAF(C) 0xB0-0xB7(M)	0x5400-0x57FF (C) 0x5800-0x5BFF (M)	0x005400-0x0057FF (C) 0x005800-0x005BFF (M)

TYPE (IEC-60870-5-101 Paragraph) (Type ID)	DESCRIPTION	DATA REPRESENTATION	INFORMATION OBJECT ADDRESS RANGE (IN HEXADECIMAL FORMAT)		
			1-Octet IOA	2-Octet IOA	3-Octet IOA
C_RC_NA_1 (IEC 60870-5-101: 7.3.2.3) (47) C_RC_TA_1 (IEC 60870-5-104: 8.3) (60)	Regulating Step Command (-101) and Regulating Step command with time tag (-104): This command is used to control a stepping device such as a transformer.	Regulating Step Command (7.2.6.17) with 0 = Not permitted 1 = Next step lower 2 = Next step higher 3 = Not permitted	0xB8-0xBF(C) 0xC0-0xC7(M)	0x5C00-0x5FFF (C) 0x6000-0x63FF (M)	0x005C00-0x005FFF (C) 0x006000-0x0063FF (M)
C_SE_NA_1 (IEC 60870-5-101: 7.3.2.4) (48) C_SE_TA_1 (IEC 60870-5-104: 8.4) (61)	Setpoint Command, Normalized Value (-101) and Setpoint Command with time tag, Normalized Value (-104): This command is used to control an analog device.	Normalized values (7.2.6.6) are stored in a word (16-bit) data area with a range of $-1..+1-2^{-15}$	0xC8-0xCF(C) 0xD0-0xD7(M)	0x6400-0x67FF (C) 0x6800-0x6BFF (M)	0x006400-0x0067FF (C) 0x006800-0x006BFF (M)
C_SE_NB_1 (IEC 60870-5-101: 7.3.2.5) (49) C_SE_TB_1 (IEC 60870-5-104: 8.5) (62)	Setpoint Command, Scaled Value (-101) and Setpoint Command with time tag, Scaled Value (-104) : This command is used to control an analog device.	Scaled values (7.2.6.7) are stored in a word (16-bit) data area with a range of $-2^{15} .. +2^{15}-1$	0xD8-0xDF(C) 0xE0-0xE7(M)	0x6C00-0x6FFF (C) 0x7000-0x73FF (M)	0x006C00-0x006FFF (C) 0x007000-0x0073FF (M)
C_SE_NC_1 (IEC 60870-5-101: 7.3.2.6) (50) C_SE_TB_1 (IEC 60870-5-104: 8.6) (63)	Setpoint Command, Short Float Value (-101) and Setpoint Command with time tag, Short Float Value (-104): This command is used to control an analog device or computation.	Short floats (7.2.6.8) are stored in a double-word (32-bit) data area in IEEE STD 754 format.	0xE8-0xEF(C) 0xF0-0xF7(M)	0x7400-0x77FF (C) 0x7800-0x7BFF (M)	0x007400-0x0077FF (C) 0x007800-0x007BFF (M)

Table 3: Information object addressing scheme

Notes:

(C): Object address in control direction (Write)

(M): Object in monitor direction (Read)

(P1): Parameter 1 (Deadband) in control direction (Write)

(M1): Parameter 1 (Deadband) in monitor direction (Read)

(M2): Parameter 2 (High limit for event transmission of metered values) in monitor direction (Read)

(M3): Parameter 3 (Low limit for event transmission of metered values) in monitor direction (Read)

5.2.3 Supported IEC-60870-5-101/104 Monitoring Types

5.2.3.1 Single-point information M_SP_NA_1

One block of up to 1024 (8 for 1-byte information object address, see Table 2) of contiguous IEC-60870-5-101/104 M_SP_NA_1 single point Information variables can be defined and mapped to SIXNET X registers within any given IPm station.

The starting address of the mapped SIXNET X block, i.e. the address of the first mapped X register, as well as the number of M_SP_NA_1 objects, i.e. the number of mapped X registers, are configurable

The first configured M_SP_NA_1 single point information object within the block has the following IEC information object address (IOA):

- 0x00 if length of Information Object Address is 1 octet
- 0x0000 if length of Information Object Address is 2 octets
- 0x000000 if length of Information Object Address is 3 octets

Also If any C_SC_NA_1 single control information objects block have been mapped to Y registers (see 5.2.4), one block of up to 1024 (8 for 1-byte information object address, see Table 2) of contiguous M_SP_NA_1 single point information variables will be mapped to the same Y registers, in order to provide for monitoring capabilities to C_SC_NA_1 discrete output (control) objects.

The first configured M_SP_NA_1 discrete output monitoring single point information object, has the following IEC information object address (IOA):

- 0xA0 if length of Information Object Address is 1 octet
- 0x5000 if length of Information Object Address is 2 octets
- 0x005000 if length of Information Object Address is 3 octets

The numbers of SIXNET X and Y registers mapped to single-point information IEC objects are independently configurable.

If the user sets the number of M_SP_NA_1 objects mapped to SIXNET X registers to 0, no SIXNET X registers will be reported as M_SP_NA_1 objects by the IPm.

If the user sets the number of C_SC_NA_1 single control information objects mapped to SIXNET Y registers to 0, no SIXNET Y registers will be reported as M_SP_NA_1 objects by the IPm.

If the user sets both, the number of M_SP_NA_1 objects mapped to SIXNET X and the number of C_SC_NA_1 objects mapped to SIXNET Y registers to 0, no M_SP_NA_1 Single-point information objects at all will exist within the IPm.

The following tables show the actual mapping-addressing scheme for M_SP_NA_1 objects as a function of the configured IEC information object address length:

SIXNET X Registers to IEC M_SP_NA_1 Object Mapping					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Register	M_SP_NA_1 IOA	SIXNET Register	M_SP_NA_1 IOA	SIXNET Register	M_SP_NA_1 IOA
X[n]	0x00 (0)	X[n]	0x0000 (0)	X[n]	0x000000 (0)
X[n+1]	0x01 (1)	X[n+1]	0x0001 (1)	X[n]	0x000001 (1)
…	…	…	…	…	…
X[n+7]*	0x07* (7)	X[n+1023]*	0x03FF* (1023)	X[n+1023]*	0x0003FF* (1023)

Table 4 SIXNET X to IEC M_SP_NA_1 object mappings

*** Configurable. The actual number of SIXNET X registers that can be mapped to M_SP_NA_1 objects can be lower, depending on how many X registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**

**** n: Configured starting SIXNET X address of the M_SP_NA_1 mapped block**

SIXNET Y Registers to IEC M_SP_NA_1 Object Mapping					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Register	M_SP_NA_1 IOA	SIXNET Register	M_SP_NA_1 IOA	SIXNET Register	M_SP_NA_1 IOA
Y[m]	0xA0 (160)	Y[m]	0x5000 (20480)	Y[m]	0x005000 (20480)
Y[m+1]	0xA1 (161)	Y[m+1]	0x5001 (20481)	Y[m+1]	0x005001 (20481)
…	…	…	…	…	…
Y[m+7]*	0xA7* (167)	Y[m+1023]*	0x53FF* (21503)	Y[m+1023]*	0x0053FF* (21503)

Table 5 SIXNET Y to IEC M_SP_NA_1 object mappings

*** Configurable. The actual number of SIXNET Y registers that can be mapped to M_SP_NA_1 objects can be lower; depending on how many Y registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**

**** m: Configured starting SIXNET Y address of the C_SC_NA_1 mapped block**

SIXNET X and Y registers mapped as IEC-6080 70-5-101/104 Single Point Information With Quality Descriptor points are reported as follows:

- Single Point Information (SPI) Bit (Bit 0) = 0 or 1, *current state of SIXNET X register*
- Reserve (RES) (Bit 1) = 0, *Reserved*

- Reserve (RES) (Bit 2) = 0, *Reserved*
- Reserve (RES) (Bit 3) = 0, *Reserved*
- Blocked (BL) (Bit 4) = 0, *Not Blocked*
- Substituted (SB) (Bit 5) = 0, *Not Substituted*
- Not Topical (NT) (Bit 6) = 0, *Topica*l
- Invalid (IV) (Bit 7) = 0, *Valid*

This means that the value reported for the mapped SIXNET register is 0x01 if the corresponding binary register is ON or 0x00 if the corresponding register is OFF.

5.2.3.2 Double-point information M_DP_NA_1

One block of up to 1024 (8 for 1-byte information object address, see Table 2) of contiguous IEC-60870-5-101/104 M_DP_NA_1 double point Information objects can be defined and mapped to SIXNET X registers within any given IPm station.

One X register pair (two contiguous X registers) will be mapped per each M_DP_NA_1 double-point information object

The starting address of the mapped SIXNET X block, i.e. the address of the first X register of the first mapped X register pair, as well as the number of M_DP_NA_1 objects, i.e. the number of mapped X register pairs, are configurable

The first configured M_DP_NA_1 Double Point Information object within the block, which is mapped to the first X register pair, has the following IEC information object address (IOA):

- 0x08 if length of Information Object Address is 1 octet
- 0x0400 if length of Information Object Address is 2 octets
- 0x000400 if length of Information Object Address is 3 octets

Also If any C_DC_NA_1 double control objects block has been mapped to Y registers pairs (see 5.2.3.2), one block of up to 1024 (8 for 1-byte information object address, see Table 2) of contiguous M_DP_NA_1 Single Point Information variables will be mapped to same Y register pairs, in order to provide for monitoring capabilities to C_DC_NA_1 discrete output (control) objects.

The first configured M_DP_NA_1 control-monitoring double point Information object has the following IEC information object address (IOA):

- 0xB0 if length of Information Object Address is 1 octet
- 0x5800 if length of Information Object Address is 2 octets
- 0x005800 if length of Information Object Address is 3 octets

The numbers of SIXNET X and Y registers pairs mapped to double-point information objects are independently configurable.

If the user sets the number of M_DP_NA_1 objects mapped to SIXNET X register pairs to 0, no SIXNET X register pairs will be reported as M_DP_NA_1 objects by the IPm.

If the user sets the number of C_DC_NA_1 double control objects mapped to SIXNET Y register pairs to 0, no SIXNET Y register pairs will be reported as M_DP_NA_1 objects by the IPm.

If the user sets both, the number of M_DP_NA_1 objects mapped to SIXNET X pairs and the number of C_DC_NA_1 objects mapped to SIXNET Y register pairs to 0, no M_DP_NA_1 Double-point information objects at all will exist within the IPm.

The following tables show the actual mapping-addressing scheme for M_DP_NA_1 objects as a function of the configured IEC information object address length:

SIXNET X Registers to IEC M_DP_NA_1 Object Mapping					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Registers**	M_DP_NA_1 IOA	SIXNET Registers**	M_DP_NA_1 IOA	SIXNET Registers**	M_DP_NA_1 IOA
X[m], X[m+1]	0x08 (8)	X[m], X[m+1]	0x0400 (1024)	X[m], X[m+1]	0x000400 (1024)
X[m+2], X[m+3]	0x09 (9)	X[m+2], X[m+3]	0x0401 (1025)	X[m+2], X[m+3]	0x000401 (1025)
…	…	…	…	…	…
X[m+14], X[m+15]*	0x0F (15)*	X[m+2046], X[m+2047]*	0x07FF* (2047)	X[m+2046], X[m+2047]*	0x0007FF* (2047)

Table 6 SIXNET X pairs to IEC M_DP_NA_1 object mappings

*** Configurable. The actual number of SIXNET X register pairs that can be mapped to M_DP_NA_1 objects can be lower, depending on how many X registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**

**** m: Configured starting SIXNET X address of the M_DP_NA_1 mapped block**

SIXNET Y Registers to IEC M_DP_NA_1 Object Mapping					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Registers**	M_DP_NA_1 IOA	SIXNET Registers**	M_DP_NA_1 IOA	SIXNET Registers**	M_DP_NA_1 IOA
Y[n], Y[n+1]	0xB0 (176)	Y[n], Y[m+1]	0x5800 (22528)	Y[n], Y[n+1]	0x5800 (22528)
Y[n+2], Y[n+3]	0xB1 (177)	Y[n+2], Y[n+3]	0x5801 (22529)	Y[n+2], Y[n+3]	0x5801 (22529)
…	…	…	…	…	…
Y[n+14], Y[n+15]*	0xB7 (183)*	Y[n+2046], Y[n+2047]*	0x5BFF* (23551)	Y[n+2046], Y[n+2047]*	0x5BFF* (23551)

Table 7 SIXNET Y pairs to IEC M_DP_NA_1 object mappings

*** Configurable. The actual number of SIXNET Y registers that can be mapped to M_DP_NA_1 objects can be lower; depending on how many Y registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**

**** n: Configured starting SIXNET Y address of the C_DC_NA_1 mapped block**

SIXNET X and Y register pairs mapped as IEC-60870-5-101 Double Point Information With Quality Descriptor points are reported as follows:

- Double Point Information (DPI) Bits (Bit 0, Bit1) = SIXNET DI Register 1 and Register 2
  - 00 = *Indeterminate*
  - 01 = *OFF*
  - 10 = *ON*
  - 11 = *Indeterminate*
- Reserve (RES) (Bit 2) = 0, *Reserved*
- Reserve (RES) (Bit 3) = 0, *Reserved*
- Blocked (BL) (Bit 4) = 0, *Not Blocked*
- Substituted (SB) (Bit 5) = 0, *Not Substituted*
- Not Topical (NT) (Bit 6) = 0, *Topical*
- Invalid (IV) (Bit 7) = 0, *Valid*

This means that the values reported will be 0x00, 0x01, 0x02 or 0x03 depending on the corresponding value of the mapped X or Y register pair.

5.2.3.3 Step-point Information M_ST_NA_1

The SIXNET IPm IEC-60870-5 slave driver can be configured to read the all the Step Position Information objects in one of the two following modes:

- Analog Step Position Mode: In this mode, the step position part of the M_ST_NA_1 object is read from an AX register and the transient bit of the M_ST_NA_1 is read from an X register, so, in this mode of operation, one AX register and one X register must be mapped for each M_ST_NA_1 information object
- Digital Step Position Mode: In this mode, both, the step position and the transient bit are read from a contiguous block of eight (8) X registers, so, eight contiguous (8) X registers must be mapped for each M_ST_NA_1 information object. The first seven (7) X register are interpreted as the step position information in 2's complement binary representation (-64 to +63 values) and the eighth (8^{th}) bit is the Transient State bit.

One block of up to 1024 (8 for 1-byte information object address, see Table 2) contiguous IEC-60870-5-101/104 M_ST_NA_1 Monitored Step Point Information variables can be defined and mapped to SIXNET AX and X register pairs when the driver is configured in the analog step position mode or to blocks of eight (8) X registers when the driver is configured in the binary-encoded digital step position mode.

When the driver is configured in the analog step position mode, the starting address of the mapped SIXNET AX block (for position information input) and the starting address of the SIXNET X block (for transient state input), i.e. the address of the first mapped AX, X register pair, as well as the number of M_ST_NA_1 objects, i.e. the number of mapped AX, X register pairs, are configurable. One (1) AX and one (1) X register must be allocated per M_ST_NA_1 object

When the driver is configured in the digital step position mode, the starting address of the mapped SIXNET X block (for position and transient state information input), i.e. the address of the first mapped X register, as well as the number of M_ST_NA_1 objects, i.e. the number of mapped X registers are configurable. Eight (8) X registers must be allocated per M_ST_NA_1 object

The first configured M_ST_NA_1 Step Point Information object within the block, has the following IEC information object address (IOA):

- 0x10 if length of Information Object Address is 1 octet
- 0x0800 if length of Information Object Address is 2 octets
- 0x000800 if length of Information Object Address is 3 octets

Also If any C_RC_NA_1 regulating step command information objects register block have been mapped to Y register pairs (see 00), the user must also create one block of up to 1024 (8 for 1-byte information object address, see Table 2) of contiguous M_ST_NA_1 step point information objects, in a M_ST_NA_1 object per C_RC_NA_1 object basis, in order to provide for monitoring capabilities to C_RC_NA_1 regulating step command objects and then map the so created M_ST_NA_1 either to their own sets of contiguous AX, X register pairs (if the driver has been configured in the Analog step position information mode) or to their own sets of contiguous groups of eight (8) X registers (if the driver has been configured in the digital step position information mode)

The first configured M_ST_NA_1 step point information object provided for monitoring of C_RC_NA_1 regulating step command information objects has the following IEC information object address (IOA):

- 0xC0 if length of Information Object Address is 1 octet
- 0x6000 if length of Information Object Address is 2 octets
- 0x006000 if length of Information Object Address is 3 octets

The numbers of SIXNET AX and AY registers mapped to M_ST_NA_1 information objects are independently configurable.

If the user sets the number of M_ST_NA_1 objects to 0, no SIXNET AX or X registers will be reported as M_ST_NA_1 objects by the IPm.

If the user sets the number of C_RC_NA_1 single control information objects mapped to 0, no M_ST_NA_1 monitoring objects for C_RC_NA_1 monitoring will be created or reported by the IPm.

If the user sets both, the number of M_ST_NA_1 objects and the number of C_RC_NA_1 objects to 0, no M_ST_NA_1 information objects at all will exist within the IPm.

The following tables show the actual mapping-addressing scheme for M_ST_NA_1 objects as a function of the configured IEC information object address length:

SIXNET AX and X Registers to IEC M_ST_NA_1 Object Mapping Analog Step Position Mode					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Register**	M_ST_NA_1 IOA	SIXNET Register**	M_ST_NA_1 IOA	SIXNET Register**	M_ST_NA_1 IOA
AX[n], X[m]	0x10 (16)	AX[n], X[m]	0x0800 (2048)	AX[n], X[m]	0x000800 (2048)
AX[n+1], X[m+1]	0x11 (17)	AX[n+1], X[m+1]	0x0801 (2049)	AX[n+1], X[m+1]	0x000801 (2049)
…	…	…	…	…	…
AX[n+7], X[m+7]*	0x17* (23)	AX[n+1023], X[m+1023]*	0x0BFF* (3071)	AX[n+1023], X[m+1023]*	0x000BFF* (3071)

Table 8 SIXNET AX to IEC M_ST_NA_1 object mappings, Analog step position mode

SIXNET AX and X Registers to IEC M_ST_NA_1 Object Mapping Digital Step Position Mode					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Register**	M_ST_NA_1 IOA	SIXNET Register**	M_ST_NA_1 IOA	SIXNET Register**	M_ST_NA_1 IOA
X[m]- X[m+7]	0x10 (16)	X[m]- X[m+7]	0x0800 (2048)	X[m]- X[m+7]	0x000800 (2048)
X[m+8]- X[m+15]	0x11 (17)	X[m+8]- X[m+15]	0x0801 (2049)	X[m+8]- X[m+15]	0x000801 (2049)
…	…	…	…	…	…
X[m+56]- X[m+63]*	0x17* (23)	X[m+8184]- X[m+8191]*	0x0BFF* (3071)	X[m+8184]- X[m+8191]*	0x000BFF* (3071)

Table 9 SIXNET AX to IEC M_ST_NA_1 object mappings, Analog step position mode

*** Configurable. The actual number of SIXNET AX, X registers that can be mapped to M_ST_NA_1 objects can be lower, depending on how many AX registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**

**** n, m: Configured starting SIXNET AX and X address of the M_ST_NA_1 mapped block**

SIXNET AY, X Registers to IEC M_ST_NA_1 Object Mapping (for C_RC_NA_1 monitoring) Analog Step Position Mode					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Register**	M_ST_NA_1 IOA	SIXNET Register**	M_ST_NA_1 IOA	SIXNET Register**	M_ST_NA_1 IOA
AX[j], X[k]	0xC0 (192)	AX[j], X[k]	0x6000 (24576)	AX[j], X[k]	0x006000 (24576)
AX[j+1], X[k+1]	0xC1 (193)	AX[j+1], X[k+1]	0x6001 (24577)	AX[j+1], X[k+1]	0x006001 (24577)
…	…	…	…	…	…
AX[j+7], X[k+7]*	0xC7* (199)	AX[j+1023], X[k+1023]*	0x63FF* (25599)	AX[j+1023], X[k+1023]*	0x0063FF* (25599)

Table 10 M_ST_NA_1 object mappings for monitoring C_RC_NA_1, Analog step position mode

SIXNET AX, X Registers to IEC M_ST_NA_1 Object Mapping (for C_RC_NA_1 monitoring) Digital Step Position Mode					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Register**	M_ST_NA_1 IOA	SIXNET Register**	M_ST_NA_1 IOA	SIXNET Register**	M_ST_NA_1 IOA
X[k]- X[k+7]	0xC0 (192)	X[k]- X[k+7]	0x6000 (24576)	X[k]- X[k+7]	0x006000 (24576)
X[k+8]- X[k+15]	0xC1 (193)	X[k+8]- X[k+15]	0x6001 (24577)	X[k+8]- X[k+15]	0x006001 (24577)
…	…	…	…	…	…
X[k+56]- X[k+63]*	0xC7* (199)	X[k+8184]- X[k+8191]*	0x63FF* (25599)	X[k+8184]- X[k+8191]*	0x0063FF* (25599)

Table 11 M_ST_NA_1 object mappings for monitoring C_RC_NA_1, Digital step position mode

*** Configurable. The actual number of SIXNET AX, X registers that can be mapped to M_ST_NA_1 objects can be lower, depending on how many AX, X registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**

**** j, k: Configured starting SIXNET AX and X address of the C_RC_NA_1 monitoring M_ST_NA_1 mapped block**

SIXNET AX or AY regi sters map ped as IEC- 608070-5-101/104 M_ST_ NA_1 Step Position Point Information With Quality Descriptor points will be reported as follows:

- Step (VTI) (Bits 0-6) = SIXNET AX Register (Analog mode) or
  SIXNET X registers X[k] toX[k+6] (Digital mode)
  Step (-64 to 63)
- Transient State (T) (Bit 7) = SIXNET X register (Analog mode) or
  SIXNET Register X[k+7] (Digital mode)
  Transient State

The quality descriptor byte will be reported as follows:

- Overflow (OV) (Bit 0) = 0 *If not overflow*, 1 *if overflow*
- Reserve (RES) (Bit 1) = 0, *Reserved*
- Reserve (RES) (Bit 2) = 0, *Reserved*
- Reserve (RES) (Bit 3) = 0, *Reserved*
- Blocked (BL) (Bit 4) = 0, *Not Blocked*
- Substituted (SB) (Bit 5) = 0, *Not Substituted*
- Not Topical (NT) (Bit 6) = 0, *Topica*l
- Invalid (IV) (Bit 7) = 0, *Valid*

5.2.3.4 Normalized Measured Value M_ME_NA_1.

One block of up to 1024 (8 for 1-byte information object address, see Table 2) contiguous IEC-60870-5-101/104 M_ME_NA_1 Monitored Normalized Measured Value Information objects can be defined and mapped to SIXNET AX registers within any given IPm station.

The starting address of the mapped SIXNET AX block, i.e. the address of the first mapped AX register, as well as the number of M_ME_NA_1 objects, i.e. the number of mapped AX registers, are configurable

The first configured M_ME_NA_1 object mapped to AX registers within the block has the following IEC information object address (IOA):

- 0x18 if length of Information Object Address is 1 octet
- 0x0C00 if length of Information Object Address is 2 octets
- 0x000C00 if length of Information Object Address is 3 octets

Each AX-mapped M_ME_NA_1 object has an associated P_ME_NA_1 parameter of measured value information object that can be used by the master station in the control direction to configure the Threshold (deadband) value, the High alarm limit and the Low alarm limit of variation from the last reported event value to generate events. The supported P_ME_NA_1 parameter qualifiers are shown in the following table:

Parameter Qualifier	Description
0	Not used.
1	Threshold value (deadband). Each measured value has a user-assigned deadband value. This parameter can be set and read by the controlling device (master).
2	Smoothing factor (filtered time constant) -- NOT SUPPORTED
3	Low limit for transmission of metered values. Each measured value has a user-assigned low limit value. This value is used as the lower limit for event generation. When the measured variable falls below this limit, the variable value is reported. This parameter can be set and read by the controlling device (master).
4	High limit for transmission of metered values. Each measured value has a user-assigned high limit value. This value is used as the higher limit for event generation. When the measured variable goes above this limit, the variable value is reported. This parameter can be set and read by the controlling device (master)..
5 to 31	Reserved for standard definitions of standard -- NOT SUPPORTED
32 to 63	Reserved for special use -- NOT SUPPORTED.

Table 12 Parameter qualifiers

In addition to the P_ME_NA_1 object, the SIXNET driver creates automatically three M_ME_NA_1 objects, in order to provide for monitoring capabilities of the current values of threshold, high limit and low limit parameters

The information object address (IOA) of the first created P_ME_NA_1 parameter object is:

- 0x20 if length of Information Object Address is 1 octet

- 0x1000 if length of Information Object Address is 2 octets
- 0x001000 if length of Information Object Address is 3 octets

The information object address (IOA) of the first created M_ME_NA_1 for monitoring the associated Threshold parameter is:

- 0x28 if length of Information Object Address is 1 octet
- 0x1400 if length of Information Object Address is 2 octets
- 0x001400 if length of Information Object Address is 3 octets

The information object address (IOA) of the first created M_ME_NA_1 for monitoring the associated High Limit parameter is:

- 0x30 if length of Information Object Address is 1 octet
- 0x1800 if length of Information Object Address is 2 octets
- 0x001800 if length of Information Object Address is 3 octets

The information object address (IOA) of the first created M_ME_NA_1 for monitoring the associated Low Limit parameter is:

- 0x38 if length of Information Object Address is 1 octet
- 0x1C00 if length of Information Object Address is 2 octets
- 0x001C00 if length of Information Object Address is 3 octets

Also If any C_SE_NA_1 setpoint command normalized value information objects register block has been mapped to AY registers (see 5.2.4.7), one block of up to 1024 (8 for 1-byte information object address, see Table 2) of contiguous M_ME_NA_1 objects will be mapped to the same AY registers, in order to provide for monitoring capabilities to C_SE_NA_1 setpoint command normalized value information objects.

The first configured M_ME_NA_1 object provided for monitoring of C_SE_NA_1 command information objects has the following IEC information object address (IOA):

- 0xD0 if length of Information Object Address is 1 octet
- 0x6800 if length of Information Object Address is 2 octets
- 0x006800 if length of Information Object Address is 3 octets

The numbers of SIXNET AX and AY registers mapped to M_ME_NA_1 information objects are independently configurable.

If the user sets the number of M_ME_NA_1 objects mapped to SIXNET AX registers to 0, no SIXNET AX registers will be reported as M_ME_NA_1 objects by the IPm or P_ME_NA_1 parameter objects will exist within the IPm.

If the user sets the number of C_SE_NA_1 single control information objects mapped to SIXNET AY registers to 0, no SIXNET AY registers will be reported as M_ME_NA_1 objects by the IPm.

If the user sets both, the number of M_ME_NA_1 objects mapped to SIXNET AX and the number of C_SE_NA_1 objects mapped to SIXNET AY registers to 0, no M_ST_NA_1 or P_ME_NA_1 information objects at all will exist within the IPm.

The following tables show the actual mapping-addressing scheme for M_ME_NA_1 and P_ME_NA_1 objects as a function of the configured IEC information object address length:\

SIXNET AX Registers to IEC M_ME_NA_1 and P_ME_NA_1 Object Mappings **1-octet Object Address (Up to 8 regiters)**					
SIXNET Register**	M_ME_NA_1 IOA (Mapped AX)	P_ME_NA_1 IOA (Parameter)	M_ME_NA_1 IOA (Threshold)	M_ME_NA_1 IOA (High Limit)	M_ME_NA_1 IOA (Low Limit)
AX[n]	0x18 (24)	0x20 (32)	0x28 (40)	0x30 (48)	0x38 (56)
AX[n+1]	0x19 (25)	0x21 (33)	0x29 (41)	0x31 (49)	0x39 (57)
…	…	…	…	…	…
AX[n+7]*	0x1F* (31)	0x27* (39)	0x2F* (47)	0x37* (55)	0x3F* (63)

Table 13 SIXNET AX to IEC M_ME_NA_1 object mappings, 1-octet IOA

SIXNET AX Registers to IEC M_ME_NA_1 and P_ME_NA_1 Object Mappings **2 and 3-octet Object Address (Up to 1024 registers)**					
SIXNET Register**	M_ME_NA_1 IOA (Mapped AX)	P_ME_NA_1 IOA (Parameter)	M_ME_NA_1 IOA (Threshold)	M_ME_NA_1 IOA (High Limit)	M_ME_NA_1 IOA (Low Limit)
AX[n]	0x0C00 (3072)	0x1000 (4096)	0x1400 (5120)	0x1800 (6144)	0x1C00 (7168)
AX[n+1]	0x0C01 (3073)	0x1001 (4097)	0x1401 (5121)	0x1801 (6145)	0x1C01 (7169)
…	…	…	…	…	…
AX[n+1023]*	0x0FFF (4095)	0x13FF (5119)	0x17FF (6143)	0x1BFF (7167)	0x1FFF (8191)

Table 14 SIXNET AX to IEC M_ME_NA_1 object mappings, 2 and 3-octets IOA

*** Configurable. The actual number of SIXNET AX registers that can be mapped to M_ME_NA_1 objects can be lower, depending on how many AX registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**

**** n: Configured starting SIXNET AX address of the M_ME_NA_1 mapped block**

SIXNET AY Registers to IEC M_ME_NA_1 Object Mapping					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Register**	M_ME_NA_1 IOA	SIXNET Register**	M_ME_NA_1 IOA	SIXNET Register**	M_ME_NA_1 IOA
AY[m]	0xD0 (16)	AY[m]	0x6800 (26624)	AY[m]	0x006800 (26624)
AY[m+1]	0xD1 (17)	AY[m+1]	0x6801 (26625)	AY[m+1]	0x006801 (26625)
…	…	…	…	…	…
AY[m+7]*	0xD7* (23)	AY[m+1023]*	0x6BFF* (27647)	AY[m+1023]*	0x006BFF* (27647)

Table 15 SIXNET AY to IEC M_ME_NA_1 object mappings

*** Configurable. The actual number of SIXNET AY registers that can be mapped to M_ME_NA_1 objects can be lower, depending on how many AY registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**

**** m: Configured starting SIXNET AY address of the C_SE_NA_1 mapped block**

SIXNET AX and AY registers mapped as IEC-608070-5-101 M_ME_NA_1 Monitored Normalized Measured Information points will be reported as follows:

- Normalized Value (NVA) (Bits 0-15) = -1 .. 1 - 2^{-15}, (-1 .. +0.999969482421875)

  16-Bit Integer Normalized Value

The IEC-608070-5 Slave Driver will normalize the value of the mapped SIXNET I/O register according to a pre-configured maximum value for the variable. If the current value of the variable exceeds the pre-configured maximum value, the OV bit in the quality descriptor byte will be set

The quality descriptor byte will be reported as described in paragraph 5.2.3.3

5.2.3.5 Scaled Measured Value M_ME_NB_1

One block of up to 1024 (8 for 1-byte information object address, see Table 2) contiguous IEC-60870-5-101/104 M_ ME_NB_1 M onitored Sca led Mea sured Value Information obj ects can be defined an d mapped to SIXNET AX registers within any given IPm station.

The starting address of the mapped SIXNET AX block, i.e. the address of the first mapped AX register, as well as the number of M_ME_NB_1 objects, i.e. the number of mapped AX registers, are configurable

The first configured M_ME_NB_1 obj ect mapp ed to AX regi sters within th e blo ck has th e fo llowing IEC information object address (IOA):

- 0x40 if length of Information Object Address is 1 octet
- 0x2000 if length of Information Object Address is 2 octets
- 0x002000 if length of Information Object Address is 3 octets

Each AX-mapped M_ME_NB_1 object has an associated P_ME_NB_1 parameter of measured value that can be used by the master station in the control direction to configure the Threshold (deadband) value of variation fro m the last re ported event value to generate eve nts. The su pported P_ME_NB_1 parameter qualifiers are shown in Table 12 Parameter qualifiers:

The information object address (IOA) of the first created P_ME_NB_1 parameter object is:

- 0x48 if length of Information Object Address is 1 octet
- 0x2400 if length of Information Object Address is 2 octets
- 0x002400 if length of Information Object Address is 3 octets

In addition to the P_ME _NB_1 obj ect, the SIXNET driver cre ates automat ically three M_ME_NB _1 objects, in order to provide for monito ring capabilities of the current values of threshold, high limit and low limit parameters

The info rmation obje ct ad dress (IOA) of the firs t created M_ME_NB_1 fo r monitoring th e asso ciated Threshold parameter is:

- 0x50 if length of Information Object Address is 1 octet
- 0x2800 if length of Information Object Address is 2 octets
- 0x002800 if length of Information Object Address is 3 octets

The information object address (IOA) of the first created M_ME_NB_1 for monitoring the associated High Limit parameter is:

- 0x58 if length of Information Object Address is 1 octet
- 0x2C00 if length of Information Object Address is 2 octets
- 0x002C00 if length of Information Object Address is 3 octets

The information object address (IOA) of the first created M_ME_NB_1 for monitoring the associated Low Limit parameter is:

- 0x60 if length of Information Object Address is 1 octet
- 0x3000 if length of Information Object Address is 2 octets
- 0x003000 if length of Information Object Address is 3 octets

Also If any C_SE_NB_1 setpoint command scaled value information objects block has been mapped to AY registers (see 5.2.4.9), one block of up to 1024 (8 for 1-byte information object address, see Table 2) of contiguous M_ME_NB_1 objects will be mapped to the same AY registers, in order to provide for monitoring capabilities to C_SE_NB_1 setpoint command scaled value information objects.

The first configured M_ME_NB_1 object provided for monitoring of C_SE_NB_1 command information objects has the following IEC information object address (IOA):

- 0xE0 if length of Information Object Address is 1 octet
- 0x7000 if length of Information Object Address is 2 octets
- 0x007000 if length of Information Object Address is 3 octets

The numbers of SIXNET AX and AY registers mapped to M_ME_NB_1 information objects are independently configurable.

If the user sets the number of M_ME_NB_1 objects mapped to SIXNET AX registers to 0, no SIXNET AX registers will be reported as M_ME_NB_1 objects by the IPm or P_ME_NB_1 parameter objects will exist within the IPm.

If the user sets the number of C_SE_NB_1 Setpoint Command Scaled Value objects mapped to SIXNET AY registers to 0, no SIXNET AY registers will be reported as M_ME_NB_1 objects by the IPm.

If the user sets both, the number of M_ME_NB_1 objects mapped to SIXNET AX and the number of C_SE_NB_1 objects mapped to SIXNET AY registers to 0, no M_ST_NB_1 or P_ME_NB_1 information objects at all will exist within the IPm.

The following tables show the actual mapping-addressing scheme for M_ME_NB_1 and P_ME_NB_1 objects as a function of the configured IEC information object address length:

SIXNET AX Registers to IEC M_ME_NB_1 and P_ME_NB_1 Object Mappings **1-octet Object Address (Up to 8 registers)**					
SIXNET Register**	M_ME_NB_1 IOA (Mapped AX)	P_ME_NB_1 IOA (Parameter)	M_ME_NB_1 IOA (Threshold)	M_ME_NB_1 IOA (High Limit)	M_ME_NB_1 IOA (Low Limit)
AX[n]	0x40 (64)	0x48 (72)	0x50 (80)	0x58 (88)	0x60 (96)
AX[n+1]	0x41 (65)	0x49 (73)	0x51 (81)	0x59 (89)	0x61 (97)
…	…	…	…	…	…
AX[n+7]*	0x47* (71)	0x4F* (79)	0x57* (87)	0x5F* (95)	0x67* (103)

Table 16 SIXNET AX to IEC M_ME_NB_1 object mappings, 1-octet IOA

SIXNET AX Registers to IEC M_ME_NB_1 and P_ME_NB_1 Object Mappings 2 and 3-octet Object Address (Up to 1024 registers)					
SIXNET Register**	M_ME_NB_1 IOA (Mapped AX)	P_ME_NB_1 IOA (Parameter)	M_ME_NB_1 IOA (Threshold)	M_ME_NB_1 IOA (High Limit)	M_ME_NB_1 IOA (Low Limit)
AX[n]	0x2000 (8192)	0x2400 (9216)	0x2800 (10240)	0x2C00 (11264)	0x3000 (12288)
AX[n+1]	0x2001 (8193)	0x2401 (9217)	0x2801 (10241)	0x2C01 (11265)	0x3001 (12289)
…	…	…	…	…	…
AX[n+1023]*	0x23FF (9215)	0x27FF (10239)	0x2BFF (11263)	0x2FFF (12287)	0x37FF (14335)

Table 17 SIXNET AX to IEC M_ME_NB_1 object mappings, 2 and 3-octets IOA

*** Configurable. The actual number of SIXNET AX registers that can be mapped to M_ME_NB_1 objects can be lower, depending on how many AX registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**

**** n: Configured starting SIXNET AX address of the M_ME_NB_1 mapped block**

SIXNET AY Registers to IEC M_ME_NB_1 Object Mappings					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Register**	M_ME_NA_1 IOA	SIXNET Register**	M_ME_NA_1 IOA	SIXNET Register**	M_ME_NA_1 IOA
AY[m]	0xE0 (224)	AY[m]	0x7000 (28672)	AY[m]	0x007000 (28672)
AY[m+1]	0xE1 (225)	AY[m+1]	0x7001 (28673)	AY[m+1]	0x007001 (28673)
…	…	…	…	…	…
AY[m+7]*	0xE7* (239)	AY[m+1023]*	0x73FF* (29695)	AY[m+1023]*	0x0073FF* (29695)

Table 18 SIXNET AY to IEC M_ME_NB_1 object mappings

*** Configurable. The actual number of SIXNET AY registers that can be mapped to M_ME_NB_1 objects can be lower, depending on how many AY registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**

**** m: Configured starting SIXNET AY address of the C_SE_NB_1 mapped block**

SIXNET registers mapped as IEC-608070-5 101/104 Monitored Scaled Measured Information points will be reported as follows:

- Scaled Value (SVA) (Bits 0-15) = -2^{15} .. 2^{15}- 1 (-32768 .. +32767), *16-Bit Integer Value*

The IEC-608070-5-101 Slave Driver will convert the value of the mapped SIXNET I/O register to a 16-Bit integer value. If the current value of the variable cannot be represented as a 16-Bit Integer value, the OV bit in the quality descriptor byte will be set

The quality descriptor byte will be reported as described in paragraph 5.2.3.3

5.2.3.6 Short floating point measured value M_NE_NC_1

One block of up to 1024 (8 for 1-byte information object address, see Table 2) contiguous IEC-60870-5-101/104 M_ME_NC_1 Monitored Measured Value Short Floating Point Number Information objects can be defined and mapped to SIXNET FX registers within any given IPm station.

The starting address of the mapped SIXNET FX block, i.e. the address of the first mapped FX register, as well as the number of M_ME_NC_1 objects, i.e. the number of mapped FX registers, are configurable

The first configured M_ME_NC_1 object mapped to FX registers within the block has the following IEC information object address (IOA):

- 0x68 if length of Information Object Address is 1 octet
- 0x3400 if length of Information Object Address is 2 octets
- 0x003400 if length of Information Object Address is 3 octets

Each FX-mapped M_ME_NC_1 object has an associated P_ME_NC_1 parameter of measured value that can be used by the master station in the control direction to configure the Threshold (deadband) value of variation from the last reported event value to generate events. The supported P_ME_NC_1 parameter qualifiers are shown in Table 12 Parameter qualifiers:

The information object address (IOA) of the first created P_ME_NC_1 parameter object is:

- 0x70 if length of Information Object Address is 1 octet
- 0x3800 if length of Information Object Address is 2 octets
- 0x003800 if length of Information Object Address is 3 octets

In addition to the P_ME_NC_1 object, the SIXNET driver creates automatically three M_ME_NC_1 objects, in order to provide for monitoring capabilities of the current values of threshold, high limit and low limit parameters

The information object address (IOA) of the first created M_ME_NC_1 for monitoring the associated Threshold parameter is:

- 0x78 if length of Information Object Address is 1 octet
- 0x3C00 if length of Information Object Address is 2 octets
- 0x003C00 if length of Information Object Address is 3 octets

The information object address (IOA) of the first created M_ME_NC_1 for monitoring the associated High Limit parameter is:

- 0x80 if length of Information Object Address is 1 octet
- 0x4000 if length of Information Object Address is 2 octets
- 0x004000 if length of Information Object Address is 3 octets

The information object address (IOA) of the first created M_ME_NC_1 for monitoring the associated Low Limit parameter is:

- 0x88 if length of Information Object Address is 1 octet
- 0x4400 if length of Information Object Address is 2 octets
- 0x004400 if length of Information Object Address is 3 octets

Also If any C_SE_NC_1 S etpoint Command, Short Float ing Point Value information obje cts block ha s been map ped to FY re gisters (see 5.2. 4.11), one bl ock of up to 1024 (8 for 1 -byte info rmation obj ect address, see Table 2) of contig uous M_ME_NC_1 o bjects will be mapped to the sa me FY regi sters, in order to provide for monitoring capabilities to C_SE_NC_1 setpoint comm and scaled val ue information objects.

The first configured M_ME_NC_1 obje ct provide d for monito ring of C_SE_NC_1 comma nd information objects has the following IEC information object address (IOA):

- 0xF0 if length of Information Object Address is 1 octet
- 0x7800 if length of Information Object Address is 2 octets
- 0x007800 if length of Information Object Address is 3 octets

The numb ers of SIXNET FX and FY registe rs mapped to M_ME_NC_ 1 information objects a re independently configurable.

If the user sets the number of M_ME_NC_1 objects mapped to SIXNET FX registers to 0, no SIXNET FX registers will be reported as M_ME _NC_1 objects by the IPm o r P_ME_NC_1 parameter objects will exist within the IPm.

If the user se ts the numbe r of C_SE_NC_1 Setpoi nt Comma nd, Short Floatin g Point Value informati on objects mapped to SIXNET FY regi sters to 0, no SI XNET FY regist ers will be reported as M_ME_NC_1 objects by the IPm.

If the user sets both, the numbe r of M_ME_NC_ 1 objects map ped to SIXNET FX and the num ber of C_SE_NC_1 objects mapped to SIXNET FY regi sters to 0, no M_ME_NC_1 or P_ME_NC_1 information objects at all will exist within the IPm.

The follo wing table s show the a ctual mapping-addressing scheme for M_M E_NC_1 and P_ME_NC_ 1 objects as a function of the configured IEC information object address length:

SIXNET FX Registers to IEC M_ME_NC_1 and P_ME_NC_1 Object Mappings 1-octet Object Address (Up to 8 registers)					
SIXNET Register**	M_ME_NC_1 IOA (Mapped AX)	P_ME_NC_1 IOA (Parameter)	M_ME_NC_1 IOA (Threshold)	M_ME_NC_1 IOA (High Limit)	M_ME_NC_1 IOA (Low Limit)
FX[n]	0x68 (104)	0x70 (112)	0x78 (120)	0x80 (128)	0x88 (136)
FX[n+1]	0x69 (105)	0x71 (113)	0x79 (121)	0x81 (129)	0x89 (137)
…	…	…	…	…	…
FX[n+7]*	0x6F* (111)	0x77* (119)	0x7F* (127)	0x87* (135)	0x8F* (143)

Table 19 SIXNET FX to IEC M_ME_NC_1 object mappings, 1-octet IOA

SIXNET FX Registers to IEC M_ME_NC_1 and P_ME_NC_1 Object Mappings 2 and 3-octet Object Address (Up to 1024 registers)					
SIXNET Register**	M_ME_NC_1 IOA (Mapped FX)	P_ME_NC_1 IOA (Parameter)	M_ME_NC_1 IOA (Threshold)	M_ME_NC_1 IOA (High Limit)	M_ME_NC_1 IOA (Low Limit)
FX[n]	0x3400 (13312)	0x3800 (14336)	0x3C00 (15360)	0x4000 (16384)	0x4400 (17408)
FX[n+1]	0x3401 (13313)	0x3801 (14337)	0x3C01 (15361)	0x4001 (16385)	0x4401 (17409)
…	…	…	…	…	…
FX[n+1023]*	0x37FF (14335)	0x3BFF (15359)	0x3FFF (16383)	0x43FF (17407)	0x47FF (18431)

Table 20 SIXNET FX to IEC M_ME_NC_1 object mappings, 2 and 3-octets IOA

*** Configurable. The actual number of SIXNET FX registers that can be mapped to M_ME_NC_1 objects can be lower, depending on how many FX registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**

**** n: Configured starting SIXNET FX address of the M_ME_NC_1 mapped block**

SIXNET AY Registers to IEC M_ME_NC_1 Object Mappings					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Register**	M_ME_NC_1 IOA	SIXNET Register**	M_ME_NC_1 IOA	SIXNET Register**	M_ME_NC_1 IOA
FY[m]	0xF0 (240)	FY[m]	0x7800 (30720)	FY[m]	0x007800 (30720)
FY[m+1]	0xF1 (241)	FY[m+1]	0x7801 (30721)	FY[m+1]	0x007801 (30721)
…	…	…	…	…	…
FY[m+7]*	0xF7* (247)	FY[m+1023]*	0x7BFF* (31743)	FY[m+1023]*	0x007BFF* (31743)

Table 21 SIXNET FY to IEC M_ME_NC_1 object mappings

*** Configurable. The actual number of SIXNET FY registers that can be mapped to M_ME_NC_1 objects can be lower, depending on how many FY registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**

**** m: Configured starting SIXNET FY address of the C_SE_NC_1 mapped block**

SIXNET registers mapped as IEC-60 8070-5-101 Monitored Short Floating Point Measured Information points will be reported as follows:

- FP Value (R32-IEEE STD 574) (Bits 0-31) = *IEEE STD 574 Floating point value*

The IEC-608070-5-101 SIave Driver will convert the value of the mapped SIXNET I/O register to an IEEE STD 754 floating point value. If the current value of the variable cannot be represented as a floating-point value, the OV bit in the quality descriptor byte will be set

The quality descriptor byte will be reported as described in paragraph 5.2.3.3

5.2.3.7 Integrated Totals-point Information M_IT_NA_1

One block of up to 1024 (8 for 1-byte information object address, see Table 2) contiguous IEC-60870-5-101/104 M_IT_NA_1 Monitored Integrated Total point Information objects can be defined and mapped to SIXNET LX registers within any given IPm station.

The starting address of the mapped SIXNET LX block, i.e. the address of the first mapped LX register, as well as the number of M_IT_NA_1 objects, i.e. the number of mapped LX registers, are configurable

The first configured M_IT_NA_1 object mapped to LX registers within the block has the following IEC information object address (IOA):

- 0x90 if length of Information Object Address is 1 octet
- 0x4800 if length of Information Object Address is 2 octets
- 0x004800 if length of Information Object Address is 3 octets

The number of SIXNET LX registers mapped to M_ME_NC_1 information objects is configurable.

If the user sets the number of M_IT_NA_1 objects mapped to SIXNET LX registers to 0, no SIXNET LX registers will be reported as M_IT_NA_1 objects by the IPm

The following tables show the actual mapping-addressing scheme for M_IT_NA_1 objects as a function of the configured IEC information object address length:

SIXNET AY Registers to IEC M_IT_NA_1 Object Mappings					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Register**	M_IT_NA_1 IOA	SIXNET Register**	M_IT_NA_1 IOA	SIXNET Register**	M_IT_NA_1 IOA
LX[m]	0x90 (144)	LX[m]	0x4800 (18432)	LX[m]	0x004800 (18432)
LX[m+1]	0x91 (145)	LX[m+1]	0x4801 (18433)	LX[m+1]	0x004801 (18433)
…	…	…	…	…	…
LX[m+7]*	0x97* (151)	LX[m+1023]*	0x4BFF* (19455)	LX[m+1023]*	0x004BFF* (19455)

Table 22 SIXNET LX to IEC M_IT_NA_1 object mappings

*** Configurable. The actual number of SIXNET LX registers that can be mapped to M_IT_NA_1 objects can be lower, depending on how many LY registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**

**** m: Configured starting SIXNET LX address of the M_IT_NA_1 mapped block**

LX SIXNET registe rs m apped a s IEC-6080 70-5-101/104 M_IT_ NA_1 Mo nitored Integ rated Total-p oint Information points will be reported as follows:

- Counter Value (BCR) (Bits 0-31) = Counter Value, *32-Bit Integer (-2^{31} ..+ $2^{31} - 1$)*
- Sequence (SQ) (Bits 32-36) = 0, (0 .. 31)
- Carry (CY) (Bit 37) = 0, *No carry*
- Adjusted (CA) (Bit 38) = Set when counter is reset
- Invalid (IV) (Bit 39) = 0, *Valid*

5.2.3.8 Normalized Measured Value without quality descriptor M_ME_ND_1

Same as the mapping type described in paragraph 5.2.3.4, but without quality descriptor byte.

5.2.4 Supported IEC-60870-5-101/104 Command Types

5.2.4.1 Single-point Command C_SC_NA_1

One block of up to 1024 (8 for 1-byte information object address, see Table 2) of contiguous IEC-60870-5-101/104 C_SC_ NA_1 Single Point Command information objects can be defined and mapped to SIXNET Y registers within any given IPm station.

The starting address of the mapped SIXNET Y block, i.e. the address of the first mapped Y register, as well as the number of C_SC_NA_1 objects, i.e. the number of mapped Y registers, are configurable

The first configured C_SC_NA_1 single point information object within the block, has the following IEC information object address (IOA):

- 0x98 if length of Information Object Address is 1 octet
- 0x4C00 if length of Information Object Address is 2 octets
- 0x004C00 if length of Information Object Address is 3 octets

For each C_SC_NA_1 Single Point Command information object, a M_SP_NA_1 single point information object will be created and mapped to the same Y register, in order to provide for monitoring capabilities to C_SC_NA_1 discrete output (control) objects. For further information regarding addressing scheme and how to access the monitoring objects, please refer to paragraph 5.2.3.1 and Table 5

The number of SIXNET Y registers mapped to C_SC_NA_1 Single Point Command information objects is configurable.

If the user sets the number of C_SC_NA_1 objects mapped to SIXNET Y registers to 0, no C_CS_NA_1 objects will exist within the IPm nor SIXNET Y registers will be mapped to M_SP_NA_1 objects

The following table shows the actual mapping-addressing scheme for C_SC_NA_1 objects as a function of the configured IEC information object address length:

SIXNET Y Registers to IEC C_SC_NA_1 Object Mappings					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Register**	C_SC_NA_1 IOA	SIXNET Register**	C_SC_NA_1 IOA	SIXNET Register**	C_SC_NA_1 IOA
Y[m]	0x98 (152)	Y[m]	0x4C00 (19456)	Y[m]	0x004C00 (19456)
Y[m+1]	0x99 (153)	Y[m+1]	0x4C01 (19457)	Y[m+1]	0x004C01 (19457)
…	…	…	…	…	…
Y[m+7]*	0x9F* (154)	Y[m+1023]*	0x4FFF* (20479)	Y[m+1023]*	0x004FFF* (20479)

Table 23 SIXNET Y to IEC C_SC_NA_1 object mappings

- **Configurable. The actual number of SIXNET Y registers that can be mapped to M_SC_NA_1 objects can be lower, depending on how many Y registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**
- **** m: Configured starting SIXNET Y address of the C_SC_NA_1 mapped block**

SIXNET Y registers mapped as IEC-608070-5-101 S_SC_NA_1 Single Point Command will be controlled by sending to the IPm the following information object value:

- Single Command State (SCS) (Bit 0) = 0 or 1, turns mapped SIXNET DO register OFF or ON
- Reserve (RES) (Bit 1) = Ignored, *Reserved*
- Qualifier (QU) (Bits 2-6) : (See below and Table 24)

  0 = No additional Definition

  1 = Short Duration Pulse

  2 = Long Duration Pulse

  3 = Persistent Output

  4-31 = Not implemented. Reserved
- Select/Execute (S/E) (Bit 7) = 0, *Execute,* 1*, Select*

The IPm accepts and implements the following Command Qualifiers:

Qualifier Code	Description
0	No additional definitions (The IPm will use persistent output for this qualifier selection).
1	Short pulse duration (circuit breaker), duration is determined by user-configured parameter
2	Long pulse duration (control relay), duration is determined by user-configured parameter
3	Persistent output of control
4 to 8	Reserved for standard definitions of standard -- NOT SUPPORTED
9 to 15	Reserved for the selection of other predefined functions -- NOT SUPPORTED
16 to 31	Reserved for special use (private range) -- NOT SUPPORTED

Table 24 Supported Command Qualifiers

5.2.4.2 Single-point Command with time tag C_SC_TA_1 (IEC-60870-5-104 only)

This object type operates the same way as C_SC_NA_1 objects (see 5.2.4.1), with the following exception:

Upon reception of a C_SC_TA_1 command, the IPm compares the time tag included in the C_SC_TA_1 object with the date and clock time of reception at the IPm, in order to calculate the transmission delay of the command. If the transmission delay exceeds the maximum allowable delay (configurable on a per station basis), the command is ignored.

The C_CS_TA_1 time tag contains the time at which the command is initiated in the controlling station.

5.2.4.3 Double-point Command C_DP_NA_1

One block of up to 1024 (8 for 1-byte information object address, see Table 2) of contiguous IEC-60870-5-101/104 C_DC_NA_1 Double Point Command information objects can be defined and mapped to SIXNET Y register pairs within any given IPm station (two Y registers per C_DC_NA_1 object).

The starting address of the mapped SIXNET Y register pair block, i.e. the address of the first Y register of the first mapped Y register pair, as well as the number of C_DC_NA_1 objects, i.e. the number of mapped Y registers pairs, are configurable

The first configured C_DC_NA_1 single point information object within the block, has the following IEC information object address (IOA):

- 0xA8 if length of Information Object Address is 1 octet
- 0x5400 if length of Information Object Address is 2 octets
- 0x005400 if length of Information Object Address is 3 octets

For each C_DC_NA_1 Single Point Command information object, a M_DP_NA_1 single point information object will be created and mapped to the same Y register pair, in order to provide for monitoring capabilities to C_DC_NA_1 discrete output (control) objects. For further information regarding addressing scheme and how to access the monitoring objects, please refer to paragraph 5.2.3.2 and Table 6

The number of SIXNET Y register pairs mapped to C_DC_NA_1 Double Point Command information objects is configurable.

If the user sets the number of C_DC_NA_1 objects mapped to SIXNET Y register pairs to 0, no C_DC_NA_1 objects will exist within the IPm nor SIXNET Y register pairs will be mapped to M_DP_NA_1 objects

The following table shows the actual mapping-addressing scheme for C_DC_NA_1 objects as a function of the configured IEC information object address length:

SIXNET Y Register pairs to IEC C_DC_NA_1 Objects Mappings					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Register**	C_DC_NA_1 IOA	SIXNET Register**	C_DC_NA_1 IOA	SIXNET Register**	C_DC_NA_1 IOA
Y[m] Y[m+1]	0xA8 (168)	Y[m] Y[m+1]	0x5400 (21504)	Y[m] Y[m+1]	0x005400 (21504)
Y[m+2] Y[m+3]	0xA9 (169)	Y[m+2] Y[m+3]	0x5401 (21505)	Y[m+2] Y[m+3]	0x005401 (21505)
…	…	…	…	…	…
Y[m+14] Y[m+15]*	0xAF* (175)	Y[m+2046] Y[m+2047]*	0x57FF* (22527)	Y[m+2046] Y[m+2047]*	0x0057FF* (22527)

Table 25 SIXNET Y pairs to IEC C_DC_NA_1 object mappings

- **Configurable. The actual number of SIXNET Y registers pairs that can be mapped to C_DC_NA_1 objects can be lower, depending on how many Y registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**
- **** m: Configured starting SIXNET Y address of the C_DC_NA_1 mapped block**

Any pair of SIXNET Y registe r pai rs mapped as IEC-608 070-5-101/104 S_DC_ NA_1 Double Point Command will be controlled by sending to the IPm the following information object:

- Double Command State (DCS) (Bits 0-1) = 00, *Not permitted*
  01, *OFF*, Turns first DO ON, second DO OFF
  10, ON, Turns first DO OFF, second DO ON
  11, *Not permitted*
- Qualifier (QU) (Bits 2-6) : (See below and Table 24)
  0 = No additional Definition
  1 = Short Duration Pulse
  2 = Long Duration Pulse
  3 = Persistent Output
  4-31 = Not implemented. Reserved
- Select/Execute (S/E) (Bit 7) = 0, *Execute,* 1*, Select*

See Table 24 Supported Command Qualifiers for det ails on how t he SIXNET IPm IEC-6 0870-5-101/104 implements and supports the command qualifiers (QU field).

5.2.4.4 Double-point Command with time tag C_DC_TA_1 (IEC-60870-5-104 only)

This obj ect type operates the same way as C_DC_NA_1 obj ects (se e 5.2.4.3), with the followin g exception:

Upon reception of a C_DC_TA_1 command, the IPm co mpares the time tag in cluded in the C_DC_TA_1 object with the date and clock time of reception at the IPm, in order to calculate the transmission delay of the comm and. If the transmissio n del ay exceed s t he maximum allowa ble de lay (co nfigurable on a p er station basis), the command is ignored.

The C_DC_TA_1 time tag contains the time at which the command is initiated in the controlling station.

5.2.4.5 Regulating Step Command C_RC_NA_1

One block of up to 1024 (8 for 1-byte information object address, see Table 2) of contiguous IEC-60870-5-101/104 C_RC_NA_1 Regulating Step Command information objects can be defined and mapped to SIXNET Y register pairs within any given IPm station ((two Y registers mapped per C_RC_NA_1 object)..

The starting address of the mapped SIXNET Y register pair block, i.e. the address of the first Y register of the first mapped Y register pair, as well as the number of C_RC_NA_1 objects, i.e. the number of mapped Y registers pairs, are configurable

The first configured C_RC_NA_1 Regulating Step Command object within the block, has the following IEC information object address (IOA):

- 0xB8 if length of Information Object Address is 1 octet
- 0x5C00 if length of Information Object Address is 2 octets
- 0x005C00 if length of Information Object Address is 3 octets

For each C_RC_NA_1 Regulating Step Command object, a M_ST_NA_1 Monitored Step Point information object will be created and mapped to user configurable AX, X register pairs or X register groups of eight (8) registers,, in order to provide for monitoring capabilities to C_RC_NA_1 objects. For further information regarding addressing scheme and how to access the monitoring objects, please refer to paragraph 5.2.3.3 and Table 10 / Table 11

The number of SIXNET Y register pairs mapped to C_RC_NA_1 Regulating Step objects is configurable.

If the user sets the number of C_RC_NA_1 objects mapped to SIXNET Y register pairs to 0, no C_RC_NA_1 objects will exist within the IPm nor SIXNET Y register pairs will be mapped to M_ST_NA_1 objects

The following table shows the actual mapping-addressing scheme for C_RC_NA_1 objects as a function of the configured IEC information object address length:

SIXNET AY Registers to IEC C_RC_NA_1 Objects Mappings					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Register**	C_RC_NA_1 IOA	SIXNET Register**	C_RC_NA_1 IOA	SIXNET Register**	C_RC_NA_1 IOA
Y[m] Y[m+1]	0xB8 (184)	Y[m] Y[m+1]	0x5C00 (23552)	Y[m] Y[m+1]	0x005C00 (23552)
Y[m+2] Y[m+3]	0xB9 (185)	Y[m+2] Y[m+3]	0x5C01 (23553)	Y[m+2] Y[m+3]	0x005C01 (23553)
…	…	…	…	…	…
Y[m+14] Y[m+15]*	0xBF* (191)	Y[m+2046] Y[m+2047]*	0x5FFF* (24575)	Y[m+2046] Y[m+2047]*	0x005FFF* (24575)

Table 26 SIXNET Y to IEC C_RC_NA_1 object mappings

- **Configurable. The actual number of SIXNET Y register pairs that can be mapped to C_RC_NA_1 objects can be lower, depending on how many Y registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**
- **** m: Configured starting SIXNET Y address of the C_RC_NA_1 mapped block**

SIXNET AY registers mapped to an IEC-60870-5-101/104 C_RC_NA_1 Regulating Step Command point will be controlled by sending to the IPm the following information object:

- Regulating Step Command State (RCS)

  (Bits 0-1) = 00, *Not permitted*
  01, *Next Step LOWER*
  10, Next Step HIGHER
  11, *Not permitted*

- Qualifier (QU) (Bits 2-6) : (See below and Table 24)

  0 = No additional Definition
  1 = Short Duration Pulse
  2 = Long Duration Pulse
  3 = Persistent Output
  4-31 = Not implemented. Reserved

- Select/Execute (S/E) (Bit 7) = 0, *Execute,* 1*, Select*

See Table 24 Supported Command Qualifiers for details on how the SIXNET IPm IEC-60870-5-101/104 implements and supports the command qualifiers (QU field).

5.2.4.6 Regulating Step Command with time tag C_RC_TA_1 (IEC-60870-5-104 only)

This object type operates the same way as C_RC_NA_1 objects (see 5.2.4.5), with the following exception:

Upon reception of a C_RC_TA_1 command, the IPm compares the time tag included in the C_RC_TA_1 object with the date and clock time of reception at the IPm, in order to calculate the transmission delay of the command. If the transmission delay exceeds the maximum allowable delay (configurable on a per station basis), the command is ignored.

The C_RC_TA_1 time tag contains the time at which the command is initiated in the controlling station.

5.2.4.7 Setpoint Command, Normalized Value C_SE_NA_1.

One block of up to 1024 (8 for 1-byte information object address, see Table 2) of contiguous IEC-60870-5-101/104 C_SE_NA_1 Setpoint Command, Normalized Value objects can be defined and mapped to SIXNET AY registers within any given IPm station.

The starting address of the mapped SIXNET AY register block, i.e. the address of the first mapped AY register, as well as the number of C_SE_NA_1 objects, i.e. the number of mapped AY registers, are configurable

The first configured C_SE_NA_1 Setpoint Command, Normalized Value object within the block, has the following IEC information object address (IOA):

- 0xC8 if length of Information Object Address is 1 octet
- 0x6400 if length of Information Object Address is 2 octets
- 0x006400 if length of Information Object Address is 3 octets

For each C_SE_NA_1 Setpoint Command, Normalized Value object, a M_ME_NA_1 Monitored Normalized Measured Value information object will be created and mapped to the same AY register, in order to provide for monitoring capabilities to C_SE_NA_1 objects. For further information regarding addressing scheme and how to access the monitoring objects, please refer to paragraph 5.2.3.4 and Table 15

The number of SIXNET AY registers mapped to C_SE_NA_1 Setpoint Command, Normalized Value objects is configurable.

If the user sets the number of C_SE_NA_1 objects mapped to SIXNET AY registers to 0, no C_SE_NA_1 objects will exist within the IPm nor SIXNET AY registers will be mapped to M_ME_NA_1 objects

The following table shows the actual mapping-addressing scheme for C_SE_NA_1 objects as a function of the configured IEC information object address length:

SIXNET AY Registers to IEC C_SE_NA_1 Objects Mappings					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Register**	C_SE_NA_1 IOA	SIXNET Register**	C_SE_NA_1 IOA	SIXNET Register**	C_SE_NA_1 IOA
AY[m]	0xC8 (200)	AY[m]	0x6400 (25600)	AY[m]	0x006400 (25600)
AY[m+1]	0xC9 (201)	AY[m+1]	0x6401 (25601)	AY[m+1]	0x006401 (25601)
…	…	…	…	…	…
AY[m+7]*	0xCF* (207)	AY[m+1023]*	0x67FF* (26623)	AY[m+1023]*	0x0067FF* (26623)

Table 27 SIXNET AY to IEC C_SE_NA_1 object mappings

- **Configurable. The actual number of SIXNET AY registers pairs that can be mapped to C_SE_NA_1 objects can be lower, depending on how many AY registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**
- **** m: Configured starting SIXNET AY address of the S_SE_NA_1 mapped block**

SIXNET AY registers mapped as IEC-608070-5-101/104 Setpoint Command, Normalized Value points will be controlled by sending to the IPm the following information object:

- Normalized Value (NVA) (Bits 0-15) = -1 .. 1 - 2^{-15}, (-1 .. +0.999969482421875)
  16-Bit Integer Normalized Value
- Qualifier of Setpoint (QL) (Bits 16-30) = Ignored, *Reserved*
- Select/Execute (S/E) (Bit 31) = 0, *Execute,* 1*, Select*

The IEC-608070-5-101/104 Slave Driver will convert the value received in the command operation to the resolution of the mapped SIXNET I/O register and then set the mapped SIXNET register to the converted value during the Setpoint operation “execute” phase

5.2.4.8 Setpoint Command with time tag, Normalized Value C_SE_TA_1 (IEC-60870-5-104 only)

This object type operates the same way as C_SE_NA_1 objects (see 5.2.4.7), with the following exception:

Upon reception of a C_SE_TA_1 command, the IPm compares the time tag included in the C_SE_TA_1 object with the date and clock time of reception at the IPm, in order to calculate the transmission delay of the command. If the transmission delay exceeds the maximum allowable delay (configurable on a per station basis), the command is ignored.

The C_SE_TA_1 time tag contains the time at which the command is initiated in the controlling station.

5.2.4.9 Setpoint Command, Scaled Value C_SE_NB_1.

One block of up to 1024 (8 for 1-byte information object address, see Table 2) of contiguous IEC-60870-5-101/104 C_SE_NB_1 Setpoint Command, Scaled Value objects can be defined and mapped to SIXNET AY registers within any given IPm station.

The starting address of the mapped SIXNET AY register block, i.e. the address of the first mapped AY register, as well as the number of C_SE_NB_1 objects, i.e. the number of mapped AY registers, are configurable

The first configured C_SE_NA_1 Setpoint Command, Scaled Value object within the block, has the following IEC information object address (IOA):

- 0xD8 if length of Information Object Address is 1 octet
- 0x6C00 if length of Information Object Address is 2 octets
- 0x006C00 if length of Information Object Address is 3 octets

For each C_SE_NB_1 Setpoint Command, Scaled Value object, a M_ME_NB_1 Monitored Scaled Measured Value information object will be created and mapped to the same AY register, in order to provide for monitoring capabilities to C_SE_NB_1 objects. For further information regarding addressing scheme and how to access the monitoring objects, please refer to paragraph 5.2.3.5 and Table 18

The number of SIXNET AY registers mapped to C_SE_NB_1 Setpoint Command, Scaled Value objects is configurable.

If the user sets the number of C_SE_NB_1 objects mapped to SIXNET AY registers to 0, no C_SE_NB_1 objects will exist within the IPm nor SIXNET AY registers will be mapped to M_ME_NB_1 objects

The following table shows the actual mapping-addressing scheme for C_SE_NB_1 objects as a function of the configured IEC information object address length:

SIXNET AY Registers to IEC C_SE_NB_1 Objects Mappings					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Register**	C_SE_NB_1 IOA	SIXNET Register**	C_SE_NB_1 IOA	SIXNET Register**	C_SE_NB_1 IOA
AY[m]	0xD8 (216)	AY[m]	0x6C00 (27648)	AY[m]	0x6C00 (27648)
AY[m+1]	0xD9 (217)	AY[m+1]	0x6C01 (27649)	AY[m+1]	0x6C01 (27649)
…	…	…	…	…	…
AY[m+7]*	0xDF* (223)	AY[m+1023]*	0x6FFF* (28671)	AY[m+1023]*	0x6FFF* (28671)

Table 28 SIXNET AY to IEC C_SE_NB_1 object mappings

- **Configurable. The actual number of SIXNET AY registers pairs that can be mapped to C_SE_NB_1 objects can be lower, depending on how many AY registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**
- **** m: Configured starting SIXNET AY address of the S_SE_NB_1 mapped block**

SIXNET AY registers mapped as IEC-608070-5-101/104 C_SE_NB_1 Setpoint Command, Scaled Value points will be controlled by sending to the IPm the following information object:

- Scaled Value (SVA) (Bits 0-15) = -2^{15} .. 2^{15}- 1 (-32768 .. +32767), *16-Bit Integer Value*
- Qualifier of Setpoint (QL) (Bits 16-30) = Ignored, *Reserved*
- Select/Execute (S/E) (Bit 31) = 0, *Execute,* 1*, Select*

The IEC-608070-5-101/104 Slave Driver will convert the value received in the command operation to the resolution of the mapped SIXNET I/O register and then set the mapped SIXNET register to the converted value during the Setpoint operation “execute” phase

5.2.4.10 Setpoint Command with time tag, Normalized Value C_SE_TB_1 (IEC-60870-5-104 only)

This object type operates the same way as C_SE_NB_1 objects (see 5.2.4.9), with the following exception:

Upon reception of a C_SE_TB_1 command, the IPm compares the time tag included in the C_SE_TB_1 object with the date and clock time of reception at the IPm, in order to calculate the transmission delay of the command. If the transmission delay exceeds the maximum allowable delay (configurable on a per station basis), the command is ignored.

The C_SE_TB_1 time tag contains the time at which the command is initiated in the controlling station.

5.2.4.11 Setpoint Command, Short Floating Point Value C_SE_NC_1

One block of up to 1024 (8 for 1-byte information object address, see Table 2) of contiguous IEC-60870-5-101/104 C_SE_NC_1 Setpoint Command, Short Floating Point Value objects can be defined and mapped to SIXNET FY registers within any given IPm station.

The starting address of the mapped SIXNET FY register block, i.e. the address of the first mapped FY register, as well as the number of C_SE_NC_1 objects, i.e. the number of mapped FY registers, are configurable

The first configured C_SE_NC_1 Setpoint Command, Short Floating Point Value object within the block, has the following IEC information object address (IOA):

- 0xE8 if length of Information Object Address is 1 octet
- 0x7400 if length of Information Object Address is 2 octets
- 0x007400 if length of Information Object Address is 3 octets

For each C_SE_NC_1 Setpoint Command, Short Floating Point Value object, a M_ME_NC_1 Monitored Short Floating Point Measured Value information object will be created and mapped to the same FY register, in order to provide for monitoring capabilities to C_SE_ NC_1 objects. For further information regarding addressing scheme and how to access the monitoring objects, please refer to paragraph 5.2.3.6 and Table 21

The number of SIXNET FY registers mapped to C_SE_NC_1 Setpoint Command, Short Floating Point Value objects is configurable.

If the user sets the number of C_SE_NC_1 objects mapped to SIXNET FY registers to 0, no C_SE_NC_1 objects will exist within the IPm nor SIXNET FY registers will be mapped to M_ME_NC_1 objects

The following table shows the actual mapping-addressing scheme for C_SE_NC_1 objects as a function of the configured IEC information object address length:

SIXNET FY Registers to IEC C_SE_NC_1 Objects Mappings					
1-octet object address (Up to 8 registers*)		2-octet object address (Up to 1024 registers*)		3-octet object address (Up to 1024 registers*)	
SIXNET Register**	C_SE_NC_1 IOA	SIXNET Register**	C_SE_NC_1 IOA	SIXNET Register**	C_SE_NC_1 IOA
FY[m]	0xE8 (232)	FY[m]	0x7400 (29696)	FY[m]	0x007400 (29696)
FY[m+1]	0xE9 (233)	FY[m+1]	0x7401 (29697)	FY[m+1]	0x007401 (29697)
…	…	…	…	…	…
FY[m+7]*	0xEF* (239)	FY[m+1023]*	0x77FF* (30719)	FY[m+1023]*	0x0077FF* (30719)

Table 29 SIXNET FY to IEC C_SE_NC_1 object mappings

- **Configurable. The actual number of SIXNET FY registers pairs that can be mapped to C_SE_NC_1 objects can be lower, depending on how many FY registers have been mapped to other compatible IEC types (see Table 1) and I/O database capacity**
- **** m: Configured starting SIXNET FY address of the S_SE_NC_1 mapped block**

SIXNET FY registers mapped as IEC-608070-5-101/104 C_SE_NC_1 Setpoint Command, Short Floating Point Value points will be controlled by sending to the IPm the following information object:

- FP Value (R32-IEEE STD 574) (Bits 0-31) = *IEEE STD 574 Floating point value*
- Qualifier of Setpoint (QL) (Bits 32-38) = Ignored, *Reserved*
- Select/Execute (S/E) (Bit 39) = 0, *Execute,* 1*, Select*

The IEC-608070-5-101/104 Slave Driver will convert the value received in the command operation to the resolution of the mapped SIXNET I/O register and then set the mapped SIXNET register to the converted value during the Setpoint operation “execute” phase.

5.2.4.12 Setpoint Command with time tag, Normalized Value C_SE_TC_1 (IEC-60870-5-104 only)

This object type operates the same way as C_SE_NC_1 objects (see 5.2.4.11), with the following exception:

Upon reception of a C_SE_TC_1 command, the IPm compares the time tag included in the C_SE_TC_1 object with the date and clock time of reception at the IPm, in order to calculate the transmission delay of the command. If the transmission delay exceeds the maximum allowable delay (configurable on a per station basis), the command is ignored.

The C_SE_TC_1 time tag contains the time at which the command is initiated in the controlling station.

5.3 IPm IEC-60850-101/104 Driver Application Functions

5.3.1 Station Initialization

The SIXNET IPm IEC-608 70-5-101/104 driver will se nd an ENDINIT message when the driv er starts or gets reloaded because of a configuration change.

Before sending the ENDINIT message, the driver clears the event queue and all communication buffers.

The En d of Initializatio n (ENDINIT) message i s a M_EI_ NA_1 ASDU me ssage with a Cau se of Initialization (COI) information object set to 0 (Unchanged local parameters / Local power switch on).

5.3.2 Data acquisition by polling

The SIXNET IPm IEC-60 870-5-101/104 drive r impl ements the data a cquisition by polli ng function as defined in IEC-60870-5-5, 6.2 and IEC-60870-5-101, 7.4.2

In IEC-60870-5-101 unbalanced mode, Class 1 and Class 2 polls are supported. ASDUs having Cause of Transmission periodic/cyclic and background scan are assigned to be transmitted with the link layer data Class 2 (low priority) data. Other ASDUs with other causes of transmission are assigned to be transmitted with Class 1 (high priority) data.

In respon se to a Cla ss 2 poll, the SIXNET IPm IEC- 60870-5-101 drive r will respon d with Class 1 data when there is no Class 2 data available.

5.3.3 Cyclic data transmission

The SIXNET IPm IEC-6 0870-5-101/104 drive r im plements the cyclic d ata t ransmission function a s defined in IEC-60870-5-5, 6.3 and IEC-60870-5-101, 7.4.3

Each point can be individually enabled to be reported using the Cyclic/Periodic transmission function

The tran smission cycle (transmission period time) is configu rable and can nev er be set to less than ten (10) seconds.

Measured values reported by the cyclic data transmission function are not rep orted as background scan (COT = 2), spontaneous (COT = 2) or station interrogation (COT = 20 to 36).

Cyclic data transmission messages reports non time-tagged objects.

5.3.4 Acquisition of events

The SIXNET IPm IEC-6 0870-5-101/104 drive r im plements Acquisition of events function as define d in IEC-60870-5-5, 6.4 and IEC-60870-5-101, 7.4.4

Change Event Objects are created and queued when a data item's value is seen to have changed when a periodic comparison against the last reported value is made.

The driver automatically calculates the rate at which periodic inspection for event detection for all points is to be made.

The periodic inspection rat e is calculated so th at a maximum sa mple rate is achi eved wit hout affecting overall respo nse time a nd performan ce of other ru nning processes withi n the IPm.. The event detectio n rate depends on the number of objects configured and in any case is never lower than 20 ms.

The maximum number of Event Objects that can be queued is configurable. The driver can be configured to rep ort events eithe r in a timely fashi on (timeo ut is co nfigurable) or when a numbe r (co nfigurable) of non-reported events in the event queue is reached.

Events are collected and reported for M_SP, M_DP and M_ME objects. The IEC-60870-5-101/104 Object Type Identification u sed to rep ort M_S P, M_DP, an d M_ME i s configurable according to t he follo wing table:

Event Object Type	Can be reported as:
M_SP	M_SP_NA_1 (Single-point information) or M_SP_TA_1 (Single-point information with CP24 time tag) or M_SP_TB_1 (Single-point information with CP56 time tag)
M_DP	M_DP_NA_1 (Double-point information) or M_DP_TA_1 (Double-point information with CP24 time tag) or M_DP_TB_1 (Double-point information with CP56 time tag)
M_ME	M_ME_NA_1 (Measured value normalized) or M_ME_TA_1 (Measured value, normalized with CP24 time tag) or M_ME_TD_1 (Measured value, normalized with CP56 time tag)

Table 30 Event reporting type configuration

In addition to M_SP, M_DP and M_ME events, the driver sends time synchronization objects events (C_CS_NA_1) to the controlling station when a change hour event of the IPm calendar clock occurs.

The driver supports priority-based event reporting. Different reporting priorities can be assigned to M_SP, M_DP and M_ME events at configuration time.

Eight (8) priority levels for event reporting, ranging from 0 to 7, are available to the user. The level 0 has the highest priority. Each supported event reporting IEC-60870-5-101/104 type can be assigned to any of the available priority levels at configuration time.

Events with higher priorities are reported first. Events with the same priority level assignment are reported in chronological order. It is recommended to assign priorities by object type, i.e., do not assign the same priority level to more than one object type. Following this recommendation will maximize the packing of objects in fewer ASDUs when reporting events, thus improving performance.

5.3.5 General Interrogation

The SIXNET IPm IEC-60870-5-101/104 driver implements the General Interrogation function as defined in IEC-60870-5-101, 7.4.5

The driver responds to controlling station's interrogation requests via C_IC_NA_1 ASDU messages. The driver accepts global and group 1-16 interrogation requests (Qualifier of interrogation QOI = 20 and 21 to 36).

Mapped monitored IEC-60870-5-101/104 objects can be assigned at configuration time to a single or to a combination of any group on a point-by-point basis

The current values of all mapped SIXNET I/O points and monitored parameters, with the exception of the points being reported by the cyclic transmission function, will be reported when the station receives a global interrogation command.

The following table shows the ASDUs involved in the station interrogation procedure:

Direction C = Control M = Monitor	Type Identification	Cause of transmission	Qualifier of interrogation
C <10	0> C_IC_NA_1	<6> ACT	<20> Global <21-46> Group 1-16
M <10	0> C_IC_NA_1	<7> ACTCON	<20> Global <21-46> Group 1-16
M	<1> M_SP_NA_1 <3> M_DP_NA_1 <5> M_ST_NA_1 <9> M_ME_NA_1 <11> M_ME_NB_1 <13> M_ME_NC_1	<20> INROGEN <21-46> INRO1-16	
M <10	0> C_IC_NA_1	<7> ACTTERM	<20> Global <21-46> Group 1-16

Table 31 Station interrogation procedure

5.3.6 Clock Synchronization

The SIXNET IPm IEC-60870-5-101/104 driver implements the Clock Synchronization function as defined in IEC-60870-5-5, 6.7 and IEC-60870-5-101, 7.4.6.

The driver sends time synchronization objects (C_CS_NA_1 with COT = 3 SPONTANEOUS) to the master every change hour of the IPm calendar clock.

Also, the driver will request time synchronization to the controlling (master station) by setting the IV bit of the qualifier octet of time objects.

The request for time synchronization to the master will occur when a configurable timeout time after the last time synchronization command received from the master elapses.

When the driver receives clock synchronization commands, the time information contained in the clock synchronization command is corrected with the value received in the previous load delay command (see 5.3.12) and then applied to the IPm internal calendar clock.

5.3.7 Command Transmission (Controls)

The SIXNET IEC-60870-5-101/104 driver implements the Command transmission function as defined in IEC-60870-5-101, 7.4.7.

The driver supports timed-out Select-Execute and Direct command transmission procedures on any of the supported command types.

The user can select between Select-Execute and Direct command operation mode at configuration time.

When the Select-Execute mode is configured, then the “Select” timeout time must be configured. The same configured select timeout value will be used for all command points. However, each “Selected” I/O point will maintain its own timer.

The “Select” timeout sets the time after a select command is received in which to wait for a valid execute command.

The Select-Execute function operates as follows:

When the master controlling station issues a select ACT message to a valid control object, the controlled IPm station will respond with either an ACTCON or a Negative ACTCON message. If the command is not valid it might return some other error with Cause of Transmission <44>..<47>.

If the ACTCON is returned to the select, the controlling master station can assume that the controlled IPm station has correctly "selected" the control object and started a “Select” timer.

The controlling master station then issues the execute ACT message. The controlled IPm station responds with either ACTCON or Negative ACTCON. If the Select timer has expired, the Negative ACTCON will be sent. If a Negative ACTCON is sent, this terminates the procedure and there is no subsequent ACTTERM sent to the master from the IPm.

The controlled IPm station will ignore the execute ACT message and send a negative ACTCON response if the Select timer has expired when the execute ACT message is received.

The driver can be configured to optionally send ACTTERM messages at the end of the C_SE control sequences.

The SIXNET IPm IEC-60870-5-101/104 slave driver can be configured to send RETURN_INF for control operation complete. RETURN_INF (monitored object) responses will be sent out to the master station before the ACTTERM message.

Extended IEC-60870-5-104 time tagged controls are supported when the driver is configured in the IEC-60870-5-104 mode. Upon reception of a time-tagged control, the IPm compares the time tag included in the received time-tagged object with the date and clock time of reception in order to calculate the transmission delay of the control. If the transmission delay exceeds the maximum allowable delay (configurable on a per station basis), the control is ignored.

The received object’s time tag contains the time at which the control is initiated in the controlling station.

5.3.8 Transmission of integrated totals (Counters)

The SIXNET IPm IEC-60870-5-101/104 driver implements the Transmission of integrated totals function as defined in IEC-60870-5-101, 7.4.8.

The driver supports all four (A = Local freeze with spontaneous transmission, B = local freeze with counter transmission by interrogation command, C = counter interrogation freeze commands with counter transmission by interrogation commands and D = counter interrogation freeze commands with spontaneous transmission) counters mode of operation. Only one counter mode of operation (A, B, C or D) can be configured and in use at any given time.

When configured in modes A or B (automatic, periodic local freeze of counters by internal clock), the local freeze period is configurable. Also, in these modes, the counter memorizing option (MEMORIZE COUNTER –freeze- or MEMORIZE INCREMENT -freeze and reset-) is configurable on a point-by-point (counter-by-counter) basis.

Mapped IEC-60870-5-101/104 counter objects can be assigned at configuration time to a specific or to a combination of any counter group (1 to 4) on a point-by-point basis

In counter modes B and C (Counter reporting by interrogation commands), the driver responds to controlling station’s counter interrogation requests via C_CI_NA_1 ASDU messages. The driver accepts and responds to general counter requests (RQT = 5) and to specific counter group (1 to 4) interrogation requests (RQT = 1 to 4).

In counter modes C and D (Freeze/ freeze and reset operations by interrogation commands) the driver supports freeze and freeze and reset counter operations on all or specific group of counters as described above.

5.3.9 Parameter Loading

The SIXNET IPm IEC-608 70-5-101/104 driver implements the Parameter loading function as defined in IEC-60870-5-101, 7.4.9.

The driver creates P_ME_NA_1, P_ME_NB_1 and P_ME_NC_1 objects automatically for each M_ME_NA_1, M_ME_NB_1 and M_ME_NC_1 measuring object respectively

The driver supports and implements the loading of Threshold, High Limit and Low Limit parameters for each measuring M_ME object

Also, the driver creates and maps three M_ME objects for each created P_ME object, in order to provide with monitoring capabilities of the current values of Threshold, High Limit and Low Limit parameters.

The monitoring M_ME objects will be included in general and group Interrogation in terrogations responses (using the same group assignments as the associated measuring object) and in background scan messages

For further details regarding P_ME and monitoring M_ME object addressing and mapping, refer to the appropriate paragraph (5.2.3.4, 5.2.3.5 and 5.2.3.6).

5.3.10 Test Procedure

The SIXNET IPm IEC-60870-5-101/104 driver implements the Test Procedure function as defined in IEC-60870-5-5, 6.12 and IEC-60870-5-101, 7.4.10.

The IEC-60870-5-101/104 driver will receive, parse and mirror both C_TS_NA_1 (IEC-60870-5-101 and 104) and C_TS_TA_1 (IEC-60870-5-104) ASDU messages.

5.3.11 File Transfer

The File Transfer function is not implemented in the current (V2.0.0) version of the SIXNET IPm IEC-60870-5-101/104 slave driver

5.3.12 Acquisition of time delay

The SIXNET IPm IEC-60870-5-101 driver implements the Acquisition of time delay function as defined in IEC-IEC-60870-5-101, 7.4.12.

The driver accepts C_CD_NA_1 spontaneous (load delay) messages from the master station and records the delay information contained in the C_CD_NA_1. The driver uses the value received in the load delay command to correct the time information included in clock synchronization commands.

5.3.13 Background Scan

The SIXNET IPm IEC-608 70-5-101 driver implements the Background Scan function as defined in IEC-IEC-60870-5-101, 7.4.13.

The background scan transmission period is configurable. If the transmission period is 0, the background scan function is disabled.

Background data will be reported as link layer Class 2 data when the driver operates in the IEC-60870-5-101 unbalanced communications mode.

Background messages will include all non- M_IT_NA_1 counter objects not configured to be reported by the cyclic/periodic transmission function.

Background scan reports non time-tagged objects.

5.3.14 Read Procedure

The SIXNET IPm IEC-60 870-5-101 driver implements the Read Procedure function as defined in IEC - IEC-60870-5-101, 7.4.13.

Any monitored object can be requested by the Read (C_RD_NA_1) command (including M_IT_NA_1 counters).

Only non time-tagged objects are returned.

5.4 IEC-60870-5 Communications

The SIXNET IPm IEC-60870-5 Slave Driver implementation supports RS-232 and RS-485 (two and four wires) over serial port communications in point-to-point and multi-point modes (IEC-60870-5-101) as well as TCP/IP (server) over LAN/WAN communications (IEC-60870-5-104)

The SIXNET IPm IEC-60870-5-101/104 Slave Driver accepts commands from an attached master unit on the network and will generate unsolicited messages. These last sets of messages can be either spontaneous or cyclic. Data transferred to the host is derived from the IPm IEC-60870-5-101/104 Slave Driver internal database. The remote master device will be able to read and control data in the database and hence the SIXNET I/O registers mapped to the database using standard control messages supported in the protocol.

5.4.1 Communications Setup

Before the SIXNET IPm IEC-60870-5-101/104 Slave Driver can exchange I/O requests with a master station, a number of run-time communications parameters must be properly configured to match those of the master station. The SIXNET I/O Tool Kit add-on configuration tool for the SIXNET IPm IEC-60870-5-101/104 Slave Driver provides the user with the ability to define and configure such run-time driver communications parameters.

The following communications parameters can be configured with the SIXNET I/O Tool Kit add-on configuration tool for the SIXNET IPm IEC-60870-5-101/104 Slave Driver:

- Data Link communications Mode of Operation, Serial Port (-101) or TCP (-104) based communications
- Serial Port to attach to the driver for Serial Port (-101) mode of operation
- Data Link Layer Services as per IEC-60870-5-101 (Serial port based communications) and IEC-60870-5-104 (LAN/WAN based communications over TCP)

5.4.2 Real Time Data Trace

The IPm IEC-60870-5-101/104 Slave Driver can be configured to generate real time data trace of every Master-Slave transaction for diagnosis and debugging purposes. The real-time communications data traces can be enabled/disabled at any time from the SIXNET I/O Tool Kit Configuration add-on and its ASCII output can be redirected either to a text file within the IPm file system for later upload, to a dumb terminal attached to an unassigned serial port of the IPm, or even to a remote telnet terminal session over the TCP/IP network.

6. Run-Time Driver configuration

The run-time behavior and functionality of the slave driver is defined by an ASCII-text INI file which is located in the `/etc/stacfg` directory of the IPm flash filesystem. The name of the INI file is `sxiec60870drv.ini`.

The `sxiec60870drv.ini` shall be created and maintained with the Windows Tool Kit configuration Add-On and downloaded to the IPm station using the SIXNET I/O Tool Kit User Files download feature

The driver monitors every 10 seconds for configuration changes in the INI and in the serial port configuration files and reloads if either file changes.

Note: When the driver reloads, all non-reported events in the event queue and all communication frames in receive and transmit buffers are cleared.

6.1 Configuration tool requirements

The Run-Time SIXNET IPm IEC-60870-5 slave driver shall be configurable by the means of a Microsoft Windows based configuration add-on tool, which shall be integrated to the SIXNET I/O Tool Kit via the SIXNET's sxaddon.dll library. The configuration add-on tool shall be developed in Microsoft Visual Basic 6. The user shall have the ability to configure at least the following:

- Mapping of Supported IEC-60870-5-101 data objects to SIXNET IPm database I/O registers
- Communication mode: Serial Port based (IEC-60870-5-101) or TCP/IP based (IEC-60870-5-104)
- Communications parameters (Baud rate, timeouts, retries, etc)

The communications between the Configuration Add-On and the Run-Time module shall be via an ASCII text file generated and maintained by the Configuration Add-On, and downloadable to the IPm stations by the means of the "User Files download" function of the SIXNET I/O Tool Kit.

The configuration Add-On program shall make use of all current sxaddon.dll functions in order to automate as long as possible the configuration process. In particular, the configuration add-on shall perform, at least, the following functions:

- Read the list of IPm stations defined in the current project.
- Maintain an ASCII configuration file for every station that has an IEC-60870-5 driver installed and configured.
- If required, maintain a master IEC-60870-5 ASCII configuration file for the whole SIXNET I/O Tool Kit project.
- Allow the user to select a particular station from the project station list and to define its IEC-60870-5-101 slave driver configuration.
- Once the user selects a station to configure, allow the user to define the run-time slave driver communications mode (IEC-608070-5-101 or 104) and parameters.
- Automatically update the Communication Port Settings assignments in the SIXNET Tool Kit station's configuration.
- Allow the user to select and define the number of IEC-60870-5-101 data points (IEC database sizing) for each of the supported IEC-60870-5-101 data types (IEC-60870-5-101 database sizing)
- Once the number of data points for a particular IEC-60870-5-101 type has been defined, allow the user to define the starting address of the corresponding SIXNET registers mapped data block. The configuration tool shall verify and warn the user if overlapping of mapped SIXNET registers occurs.
- Once the user defines the IEC to SIXNET mapping, allow the user to set monitoring group coding on a point per point basis.
- Update the "Files to Load" property of the station's SIXNET I/O Tool Kit configuration in order to include the station's IEC-60870-5 slave driver configuration INI file in the station's files to load list
- Validate each user entry against allowed ranges as specified in this document
- Generate the driver's configuration INI file as described in section 6.2
- The generated INI file to be downloaded to the IPm station shall be named `sxiec60870drv.ini` and must be located in the `/etc/stacfg` directory of the IPm station
- The protocol name for the driver in the serial port protocol list shall be `IEC-60870-5-101`
- Maintain a local copy of the configuration INI file for each station configure in the `\Sixnet Tools\Projects` directory. The file name shall be unique and shall include the project name

and the station name. A suggested format for the file name is: `IEC_<project name>_<station name>.INI`

- The configuration tool shall provide forms for performing the following configuration actions (refer to paragraph 6.2: Configuration File format, for further details):
    - A form to display the list of stations present in the current project. This form shall appear upon launching of the configuration tool from the SIXNET I/O Tool Kit and shall be the entry point of the configuration tool. Any configuration action shall start form this form and shall operate on the station selected by the user in this form. The stations that already have an existing local copy of their configuration INI files shall be clearly marked, in order to distinguish them from those stations not configured yet. This form shall allow the user to select and configure any particular station in the list
    - A form to display, maintain and configure the common driver parameters specified in the INI file section `[SxIPmStation]` for the selected station. The form shall include buttons for Saving, Applying or Canceling changes to the station's `[SxIPmStation]` INI file section
    - A form to display, maintain and configure the link layer parameters specified in the INI file section `[DataLinkLayer]` for the selected station. The form shall include buttons for Saving, Applying or Canceling changes to the station's `[DataLinkLayer]` INI file section. If the user selects –101 link layer communications mode (serial port based), a serial port selection list shall be presented to the user. In this case, when the user saves the configuration values for this form, the configuration tool shall automatically update the Communication Port Settings assignments in the SIXNET Tool Kit station's configuration
    - A form to display, maintain and configure the application layer parameters specified in the INI file section `[ApplicationLayer]` for the selected station. The form shall include buttons for Saving, Applying or Canceling changes to the station's `[ApplicationLayer]` INI file section
    - A form or a set of forms to display, maintain and configure the object mapping parameters specified in each one of the IEC-60 870-5-101/104 object mapping and configuration INI file sections for the selected station (Sections: [M_SP_NA_1], [M_DP_NA_1], [M_ST_NA_1], [M_ME_NA_1] [M_ME_NB_1], [M_ME_NC_1], [M_IT_NA_1], [C_SC_NA_1], [C_DC_NA_1],[C_RC_NA_1], [C_SE_NA_1], [C_SE_NB_1] and [C_SE_NC_1])
    - A form callable from the object mapping parameters configuration form to display the list of SIXNET registers mapped to the corresponding IEC-60 870-5-101/04 type. The list shall display one mapped SIXNET register (or register pair for M_DP or S_DC IEC objects) per row. At least the following information (columns) shall be displayed for each mapped SIXNET Register (row): IEC Information Object Address (IOA), Sixnet I/O Address, SIXNET Tag Name, SIXNET Module Name, SIXNET Tag Descriptor and IEC Group Reporting Mask Bits. The form shall allow the user to select any mapped object (row) and to open a dialog box to configure the Group Reporting Mask Bits. The Group Reporting Mask Bits configuration dialog box shall contain 24 check boxes, one check box per Group Reporting Mask Bit (see Table 38). Each row in the mapped object list shall generate a GMxxxx entry in the corresponding IEC object type section whose value shall reflect the Group Mask Bits value in hexadecimal format (see Table 37, Table 38 and section 6.3: Sample Configuration File). The default value for the Group Mask Bits shall be 0x00000001
    - All the forms that make part of the configuration tool shall be organized in a hierarchical (tree or tabbed) fashion.

6.2 Configuration File format

The `sxiec60870drv.ini` file contains the following sections:

Section	Description
`[General]`	General information (not used by the driver. For information purpose only)
`[SxIPmStation]`	Debugging (trace) output configuration and time synchronization configuration.
`[DataLinkLayer]`	Configuration of Link Layer parameters such as station link address, link transmission timeouts and number of retries and link user data length.
`[ApplicationLayer]`	Configuration of: Common Application layer parameters such as how to report events, object and station addressing and application layer frame format

`[M_SP_NA_1]`
`[M_DP_NA_1]`
`[M_ST_NA_1]`
`[M_ME_NA_1]`
`[M_ME_NB_1]`
`[M_ME_NC_1]`
`[M_IT_NA_1]`
`[C_SC_NA_1]`
`[C_DC_NA_1]`
`[C_RC_NA_1]`
`[C_SE_NA_1]`
`[C_SE_NB_1]`
`[C_SE_NC_1]`
	Configuration of IEC-608 070-5-101/104 object block parameters such as block length, SIXNET mapping, event reporting and interrogation object grouping

Table 32 Configuration File Sections

6.2.1 [General] Section parameter description

Section Item (Key)	Range/Type	Description
`Project`	`String`	Name of the SIXNET I/O Tool Kit project this configuration belongs to. (Not used by the driver. Information only.)
`IPmStation`	String	Station Name. (Not used by the driver. Information only.)
`Version`	Number	Version number of the run-time this configuration file is intended to. (Not used by the driver. Information only.)

Table 33 [General] section parameters

6.2.2 [SxIPmStation] Section parameter description

Section Item (Key)	Range/Type	Description
`EnableDataTraces`	Yes / No	Enable / Disable run-time debugging (trace) output
`DeviceDataTraces`	String	Device to where the run-time debugging output will be redirected. If data traces is enabled and this value is left blank, the output will be sent to the controlling terminal from where the driver was launched.
`NumberTraces`	String	If the device to where the run-time debugging output is redirected is a file, this parameter specifies the maximum number of lines that will be written to the file.

Table 34 [SxIPmStation] section parameters

6.2.3 [DataLinkLayer] Section parameter description

Section Item (Key)	Range/Type	Description

Section Item (Key)	Range/Type	Description
thisStationLinkAddr	0-254 (1 octet) or 0-65534 (2-octets)	This parameter specifies the Link address of the station
LinkAddrLen	1 or 2	This parameter specifies the number of octets used to define the Link address of the station
ctrlMaxFrameLen	32-255	This parameter specifies the maximum number of octets of data portion of link frames in control direction
monMaxFrameLen	32-255	This parameter specifies the maximum number of octets of data portion of link frames in monitor direction
linkRetries	0-255	This parameter specifies the number of link transmission retries if a response is not received
linkTxTimeout	0-65535	This parameter specifies the minimum number of ms to wait for a response to a primary message. Do not set this parameter too small or timeout conditions may prevent successful data transmission. If the timeout is elapsed, the message will be retransmitted up to the number of times specified in the linkRetries parameter.
testLinkTimer	0-65535	This parameter specifies the number of ms that must elapse without any link transmission activity to send link layer TEST_LINK messages to the master station (Keepalive messages). A value of 0 will disable the function

Section Item (Key)	Range/Type	Description
AorBStationIsA	Yes / No	This parameter controls the value of the DIR bit in the control octet of link frames sent by the IPm station. If set to “YES, the DIR bit will be “1” (A to B direction). If set to “NO””the DIR bit will be “0” (B to A direction). Because the IPm is a controlled (B) station, it is recommended to set this parameter to “NO”
BalancedMode	Yes / Np	Use balanced mode of communications
layerType	101 or 104	This parameter specifies the communications interface mode of the driver 101 = Serial port IEC-60870-5-101 slave 104 = TCP server based IEC-60870-5-104 slave
104t1	Number	Timeout (ms) to acknowledge a sent packet before closing the connection
104t2	Number	Timeout (ms) when to send S-format message to acknowledge pending Rx messages
104t3	Number	Timeout (ms) on an idle line to send TESTFR.act messages
104k	Number	Number of unacknowledged messages the unit will buffer
104w	Number	Number of messages to receive when there are no I-format messages to send before sending S-format ACK message
wStartDT	Yes/No	Wait for STARTDT.con message after TCP connection from master before starting to exchange data
clUnackBuff_104	Yes/No	Clear transport interface unacknowledged transmit buffer on connect

Table 35 [LinkLayer] section parameters

6.2.4 [ApplicationLayer] Section parameter description

Section Item (Key)	Range/Type	Description
cotLen	1 or 2	This parameter specifies the number of octets used to define the ASDU Cause of transmission (COT)
oaddrLen	1, 2 or 3	This parameter specifies the number of octets used to define the address of an information object (IOA or point address).
commAddrLen	1 or 2	This parameter specifies the number of octets used for the common address of ASDU.
commAddrASDU	0-254 (1 octet) or 0-65534 (2-octets)	This parameter specifies the common address of the ASDU (station address) for access the data in the station. There is only one value entered for access to all data in the station.
timeSynchFreq	0-65535	Time synchronization request timeout (minutes). The driver will request time synchronization to the master, via IV bit of time tag of information objects, if no time synchronization command from the master has been received during the time specified by this parameter
SpontaneousReportTime	0-65535	This parameter defines the time period, in ms, the driver checks if the event buffer contains events to report. If 0, the timed check of the event queue is disabled
eventQueueThreshold	0-1024	If the number of non-reported events in the event queue is greater that this parameter, the events will be reported immediately. If 0, the number of events in queue check is disabled
eventQueueLength	0-8192	Master Event queue size. If 0, event collection and reporting is disabled

Section Item (Key)	Range/Type	Description
masterEventEnable	Yes / No	Enable/Disable event collection/reporting
selectTimeout	0-65535	This parameter defines the Select-execute timeout for all controlled outputs (ms). If 0 the Select-Execute function will be disabled and the driver will operate in direct command output mode
shortPulseDuration	100-5000	Short pulse duration for short pulse commands in ms
longPulseDuration	100-10000	Long pulse duration for short pulse commands in ms
returnInfControlComplete	Yes / No	This parameter defines if M_SP/M_DP with cause of transmission = 11 (RETREM) is sent to the master after execution of output commands (IEC-60870-5-101 RETURN_INF function)
cyclicTimer	0 - 864000000	This parameter is used to define the number of milliseconds between cyclic updates. If set to be < 1000, the driver will internally set this parameter to 1000 ms
C_SEActterm	Yes/No	Send ACTTERM after processing C_SE commands
BackgroundTimer	Number	Background poll timer (ms) (0 = Disable)
allowedCtrlTime	Number	Allowed time window (ms) to apply control commands when receiving -104 time tagged controls. (Discard commands that have been delayed in transmission for more than a maximum (this) permissible time.

Table 36 [ApplicationLayer] section parameters

6.2.5 [M_SP_NA_1] Section parameter description

Section Item (Key)	Range/Type	Description

Section Item (Key)	Range/Type	Description
Size	0 to 1024	This parameter specifies the number of M_SP_NA_1 objects that will be mapped to X registers Note: If oaddrLen parameter in [ApplicationLayer] section is 1 (1-byte IOA), this value can't be greater than 8 If 0, no M_SP_NA_1 objects will be mapped to X registers
FirstX	Number	This parameter specifies SIXNET address of the first X register mapped to the block
EventPrio	0-7	This parameter defines the reporting priority assigned to M_SP events (0 = highest) Highest priority events will be reported first. Events of same IEC-60870-5-101 type assigned to the same priority are reported in chronological order
EventReportAs	M_SP_NA_1 or M_SP_TA_1 or M_SP_TB_1	This parameter defines the type ID used to report IEC-60870-5-101 M_SP change events
GM0000	0x00000000 – 0xFFFFFFFF	This parameter defines the group reporting mask for the first mapped point (point number 0000) (See Table 38)
…	… …	
GM<Size>*	0x00000000 – 0xFFFFFFFF	This parameter defines the group reporting mask for the last mapped point (See Table 38)

Table 37 [M_SP_NA_1] section parameters

***: Determined by "Size" parameter**

The following table defines the group reporting assignments configuration. The configuration tool shall generate the appropriate mask for each mapped point:

GROUP MASK	DESCRIPTION
0x00000001	Interrogated by general interrogation (station or global)
0x00000002	Interrogated by group 1 interrogation

0x00000004	Interrogated by group 2 interrogation
0x00000008	Interrogated by group 3 interrogation
0x00000010	Interrogated by group 4 interrogation
0x00000020	Interrogated by group 5 interrogation
0x00000040	Interrogated by group 6 interrogation
0x00000080	Interrogated by group 7 interrogation
0x00000100	Interrogated by group 8 interrogation
0x00000200	Interrogated by group 9 interrogation
0x00000400	Interrogated by group 10 interrogation
0x00000800	Interrogated by group 11 interrogation
0x00001000	Interrogated by group 12 interrogation
0x00002000	Interrogated by group 13 interrogation
0x00004000	Interrogated by group 14 interrogation
0x00008000	Interrogated by group 15 interrogation
0x00010000	Interrogated by group 16 interrogation
0x00020000	Interrogated by general counter request
0x00040000	Interrogated by group 1 counter request
0x00080000	Interrogated by group 2 counter request
0x00100000	Interrogated by group 3 counter request
0x00200000	Interrogated by group 4 counter request
0x00400000	Freeze and Reset counter (1) / Freeze counter (0)
0x40000000	Disable event scanning of this point
0x80000000	Periodic/cyclic data returned from unit

Table 38 Group Reporting Mask Bits definition

6.2.6 [M_DP_NA_1] Section parameter description

Section Item (Key)	Range/Type	Description
`Size`	`0 to 1024r`	This parameter specifies the number of M_DP_NA_1 objects that will be mapped to X register pairs Note: If `oaddrLen` parameter in [`ApplicationLayer`] section is 1 (1-byte IOA), this value can't be greater than 8 If 0, no M_DP_NA_1 objects will be mapped to X registers pairs
`FirstX`	0 8192	This parameter specifies SIXNET address of the first X register of the first X register pair mapped to the block

Section Item (Key)	Range/Type	Description
EventPrio	0-7	This parameter defines the reporting priority assigned to M_DP events (0 = highest) Highest priority events will be reported first. Events of same IEC-60870-5-101 type assigned to the same priority are reported in chronological order
EventReportAs	M_DP_NA_1 or M_DP_TA_1 or M_DP_TB_1	This parameter defines the type ID used to report IEC-60870-5-101 M_DP change events
GM0000	0x00000000 – 0xFF81FFFF	This parameter defines the group reporting mask for the first mapped point (point number 0000) (See Table 38)
…	… …	
GM<Size>*	0x00000000 – 0xFF81FFFF	This parameter defines the group reporting mask for the last mapped point (See Table 38)

Table 39 [M_DP_NA_1] section parameters

***: Determined by "Size" parameter**

6.2.7 [M_ST_NA_1] Section parameter description

Section Item (Key)	Range/Type	Description
Size	0 to 1024	This parameter specifies the number of M_ST_NA_1 objects that will be mapped to AX registers Note: If oaddrLen parameter in [ApplicationLayer] section is 1 (1-byte IOA), this value can't be greater than 8 If 0, no M_ST_NA_1 objects will be mapped to AX/X registers

Section Item (Key)	Range/Type	Description
FirstAX	Number	This parameter specifies SIXNET address of the first AX register mapped to the block (Analog part when Mixed Analog/Discrete input interfacing)
FirstX	Number	This parameter specifies SIXNET address of the first X register mapped to the block (Discrete part when Mixed Analog/Discrete input interfacing or Discrete positon input when Discrete input mode)
AnalogMode	Yes/No	Interfacing type: No = Discrete input interfacing, 8 X discrete bits per object. X Bits 0-6: position (two's complement binary) X Bit 7: transient bit Yes = Analog input interfacing + discrete transient bit. AX is the position value (Integer -64 to 63). X is the transient bit
EventPrio	0-7	This parameter defines the reporting priority assigned to M_ST events (0 = highest) Highest priority events will be reported first. Events of same IEC-60870-5-101 type assigned to the same priority are reported in chronological order
EventReportAs	M_ST_NA_1 or M_ST_TA_1 or M_ST_TB_1	This parameter defines the type ID used to report IEC-60870-5-101 M_ST change events
GM0000	0x00000000 – 0xFF81FFFF	This parameter defines the group reporting mask for the first mapped point (point number 0000) (See Table 38)
…	… …	

Section Item (Key)	Range/Type	Description
GM<Size>*	0x00000000 – 0xFF81FFFF	This parameter defines the group reporting mask for the last mapped point (See Table 38)

Table 40 [M_ST_NA_1] section parameters

***: Determined by "Size" parameter**

6.2.8 [M_ME_NA_1] Section parameter description

Section Item (Key)	Range/Type	Description
Size	0 to 1024	This parameter specifies the number of M_ME_NA_1 objects that will be mapped to AX registers Note: If oaddrLen parameter in [ApplicationLayer] section is 1 (1-byte IOA), this value can't be greater than 8 If 0, no M_ME_NA_1 objects will be mapped to AX registers
FirstAX	0-8192	This parameter specifies SIXNET address of the first AX register mapped to the block
EventPrio	0-7	This parameter defines the reporting priority assigned to M_ME_NA events (0 = highest) Highest priority events will be reported first. Events of same IEC-60870-5-101 type assigned to the same priority are reported in chronological order
EventReportAs	M_ME_NA_1 or M_ME_TA_1 or M_ME_TD_1	This parameter defines the type ID used to report IEC-60870-5-101 M_ME_NA change events
DeadBand	1-32767 / Integer	Default deadband for event reporting.

Section Item (Key)	Range/Type	Description
GM0000	0x00000000 – 0xFF81FFFF	This parameter defines the group reporting mask for the first mapped point (point number 0000) (See Table 38)
…	… …	
GM<Size>*	0x00000000 – 0xFF81FFFF	This parameter defines the group reporting mask for the last mapped point (See Table 38)

Table 41 [M_ME_NA_1] section parameters

***: Determined by "Size" parameter**

6.2.9 [M_ME_NB_1] Section parameter description

Section Item (Key)	Range/Type	Description
Size	0 to 1024	This parameter specifies the number of M_ME_NB_1 objects that will be mapped to AX registers Note: If oaddrLen parameter in [ApplicationLayer] section is 1 (1-byte IOA), this value can't be greater than 8 If 0, no M_ME_NB_1 objects will be mapped to AX registers
FirstAX	0-8192	This parameter specifies SIXNET address of the first AX register mapped to the block
EventPrio	0-7	This parameter defines the reporting priority assigned to M_ME_NB events (0 = highest) Highest priority events will be reported first. Events of same IEC-60870-5-101 type assigned to the same priority are reported in chronological order
EventReportAs	M_ME_NB_1 or M_ME_TB_1 or M_ME_TE_1	This parameter defines the type ID used to report IEC-60870-5-101 M_ME_NB change events

Section Item (Key)	Range/Type	Description
DeadBand	1-32767 / Integer	Default deadband for event reporting.
GM0000	0x00000000 – 0xC001FFFF	This parameter defines the group reporting mask for the first mapped point (point number 0000) (See Table 38)
…	… …	
GM<Size>*	0x00000000 – 0xC001FFFF	This parameter defines the group reporting mask for the last mapped point (See Table 38)

Table 42 [M_ME_NB_1] section parameters

***: Determined by "Size" parameter**

6.2.10 [M_ME_NC_1] Section parameter description

Section Item (Key)	Range/Type	Description
Size	0 to 1024	This parameter specifies the number of M_ME_NC_1 objects that will be mapped to FX registers Note: If oaddrLen parameter in [ApplicationLayer] section is 1 (1-byte IOA), this value can't be greater than 8 If 0, no M_ME_NC_1 objects will be mapped to FX registers
FirstFX	0-8192	This parameter specifies SIXNET address of the first FX register mapped to the block
EventPrio	0-7	This parameter defines the reporting priority assigned to M_ME_NC events (0 = highest) Highest priority events will be reported first. Events of same IEC-60870-5-101 type assigned to the same priority are reported in chronological order

Section Item (Key)	Range/Type	Description
EventReportAs	M_ME_NC_1 or M_ME_TC_1 or M_ME_TF_1	This parameter defines the type ID used to report IEC-60870-5-101 M_ME_NC change events
DeadBand	Floating Point Number	Default deadband for event reporting.
GM0000	0x00000000 – 0xFF81FFFF	This parameter defines the group reporting mask for the first mapped point (point number 0000) (See Table 38)
…	… …	
GM<Size>*	0x00000000 – 0xFF81FFFF	This parameter defines the group reporting mask for the last mapped point (See Table 38)

Table 43 [M_ME_NC_1] section parameters

***: Determined by "Size" parameter**

6.2.11 [M_IT_NA_1] Section parameter description

Section Item (Key)	Range/Type	Description
Size	0 to 1024	This parameter specifies the number of M_IT_NA_1 objects that will be mapped to LX registers Note: If oaddrLen parameter in [ApplicationLayer] section is 1 (1-byte IOA), this value can't be greater than 8 If 0, no M_IT_NA_1 objects will be mapped to LX registers
FirstLX	0-8192	This parameter specifies SIXNET address of the first LX register mapped to the block

Section Item (Key)	Range/Type	Description
EventPrio	0-7	This parameter defines the reporting priority assigned to M_IT events (0 = highest) Highest priority events will be reported first. Events of same IEC-60870-5-101 type assigned to the same priority are reported in chronological order
EventReportAs	M_IT_NA_1 or M_IT_TA_1 or M_IT_TB_1	This parameter defines the type ID used to report IEC-60870-5-101 M_SP change events
Mode	A, B, C, D	Counter mode of operation
FreezeTimer	Number	Internal freeze period for modes A or B (ms)
EvtFrozenChgOnly	Yes/No	Only send frozen counter events when frozen counters change (modes A and D)
GM0000	0x00000000 – 0xFFFE0000	This parameter defines the group reporting mask for the first mapped point (point number 0000) (See Table 38))
…	… …	
GM<Size>*	0x00000000 – 0xFFFE0000	This parameter defines the group reporting mask for the last mapped point (See Table 38)

Table 44 [M_IT_NA_1] section parameters

***: Determined by "Size" parameter**

6.2.12 [C_SC_NA_1] Section parameter description

Section Item (Key)	Range/Type	Description

Section Item (Key)	Range/Type	Description
Size	0 to 1024	This parameter specifies the number of C_SC_NA_1 objects that will be mapped to Y registers Note: If oaddrLen parameter in [ApplicationLayer] section is 1 (1-byte IOA), this value can't be greater than 8 If 0, no C_SC_NA_1 objects will be mapped to Y registers
FirstY	0-8192	This parameter specifies SIXNET address of the first Y register mapped to the block
MonitorM_SP	Yes / No	This parameter specifies if M_SP_NA_1 monitor objects will be mapped
MonitorEvents	Yes / No	If monitor M_SP_NA_1 objects are mapped, this parameter specifies if they will generate events
EventPrio	0-7	If monitor M_SP_NA_1 events are enabled, this parameter defines the reporting priority assigned to M_SP events (0 = highest) Highest priority events will be reported first. Events of same IEC-60870-5-101 type assigned to the same priority are reported in chronological order **Note: If [M_SP_NA_1] section exists, same setting in [M_SP_NA_1] section will override this setting**
EventReportAs	M_SP_NA_1 or M_SP_TA_1 or M_SP_TB_1	If monitor M_SP_NA_1 events are enabled, this parameter defines the type ID used to report IEC-60870-5-101 M_SP change events **Note: If [M_SP_NA_1] section exists, same setting in [M_SP_NA_1] section will override this setting**

Section Item (Key)	Range/Type	Description
GM0000	0x00000000 – 0xFF81FFFF	If monitor M_SP_NA_1 objects are enabled, This parameter defines the group reporting mask for the first mapped point (point number 0000) (See Table 38)
…	… …	
GM<Size>*	0x00000000 – 0xFF81FFFF	If monitor M_SP_NA_1 objects are enabled, This parameter defines the group reporting mask for the last mapped point (See Table 38)

Table 45 [C_SC_NA_1] section parameters

***: Determined by "Size" parameter**

6.2.13 [C_DC_NA_1] Section parameter description

Section Item (Key)	Range/Type	Description
Size	0 to 1024	This parameter specifies the number of C_DC_NA_1 objects that will be mapped to Y register pairs Note: If oaddrLen parameter in [ApplicationLayer] section is 1 (1-byte IOA), this value can't be greater than 8 If 0, no C_DC_NA_1 objects will be mapped to X register pairs
FirstY	0-8192	This parameter specifies the SIXNET address of the first Y register of the first Y register pair mapped to the block
MonitorM_DP	Yes / No	This parameter specifies if M_DP_NA_1 monitor objects will be mapped
MonitorEvents	Yes / No	If monitor M_DP_NA_1 objects are mapped, this parameter specifies if they will generate events

Section Item (Key)	Range/Type	Description
EventPrio	0-7	If monitor M_DP_NA_1 events are enabled, this parameter defines the reporting priority assigned to M_DP events (0 = highest) Highest priority events will be reported first. Events of same IEC-60870-5-101 type assigned to the same priority are reported in chronological order **Note: If [M_DP_NA_1] section exists, same setting in [M_DP_NA_1] section will override this setting**
EventReportAs	M_DP_NA_1 or M_DP_TA_1 or M_DP_TB_1	If monitor M_DP_NA_1 events are enabled, this parameter defines the type ID used to report IEC-60870-5-101 M_DP change events **Note: If [M_DP_NA_1] section exists, same setting in [M_DP_NA_1] section will override this setting**
GM0000	0x00000000 – 0xFF81FFFF	If monitor M_DP_NA_1 objects are enabled, This parameter defines the group reporting mask for the first mapped point (point number 0000) (See Table 38)
…	… …	
GM<Size>*	0x00000000 – 0xFF81FFFF	If monitor M_DP_NA_1 objects are enabled, This parameter defines the group reporting mask for the last mapped point (See Table 38)

Table 46 [C_SC_NA_1] section parameters

***: Determined by "Size" parameter**

6.2.14 [C_RC_NA_1] Section parameter description

Section Item (Key)	Range/Type	Description

Section Item (Key)	Range/Type	Description
Size	0 to 1024	This parameter specifies the number of C_RC_NA_1 objects that will be mapped to AY registers Note: If oaddrLen parameter in [ApplicationLayer] section is 1 (1-byte IOA), this value can't be greater than 8 If 0, no C_RC_NA_1 objects will be mapped to AY registers
FirstY	0-8192	This parameter specifies the SIXNET address of the first Y register pair mapped to the block
FirstAX	0-8192	Monitoring Analog part when Mixed Analog/Discrete input interfacing
FirstX	0-8192	Monitoring Discrete part when Mixed Analog/Discrete input interfacing or Discrete positon input when Discrete input mode
AnalogMode	Yes/No	Monitoring Interfacing type (if no read/only M_ST_NA_1 objects defined in section [M_ST_NA_1] section) No = Discrete input interfacing, 8 X discrete bits per object. X Bits 0-6: position (two's complement binary) X Bit 7: transient bit Yes = Analog input interfacing + discrete transient bit. AX is the position value (Integer -64 to 63). X is the transient bit **Note: If [M_ST_NA_1] section exists, same setting in [M_ST_NA_1] section will override this setting**
MonitorM_ST	Yes / No	This parameter specifies if M_ST_NA_1 monitor objects will be mapped

Section Item (Key)	Range/Type	Description
MonitorEvents	Yes / No	If monitor M_ST_NA_1 objects are mapped, this parameter specifies if they will generate events.
EventPrio	0-7	If monitor M_ST_NA_1 events are enabled, this parameter defines the reporting priority assigned to M_ST events (0 = highest) Highest priority events will be reported first. Events of same IEC-60870-5-101 type assigned to the same priority are reported in chronological order **Note: If [M_ST_NA_1] section exists, same setting in [M_ST_NA_1] section will override this setting**
EventReportAs	M_ST_NA_1 or M_ST_TA_1 or M_ST_TB_1	If monitor M_ST_NA_1 events are enabled, this parameter defines the type ID used to report IEC-60870-5-101 M_ST change events **Note: If [M_ST_NA_1] section exists, same setting in [M_ST_NA_1] section will override this setting**
GM0000	0x00000000 – 0xFF81FFFF	If monitor M_ST_NA_1 objects are enabled, This parameter defines the group reporting mask for the first mapped point (point number 0000) (See Table 38)
…	… …	
GM<Size>*	0x00000000 – 0xFF81FFFF	If monitor M_ST_NA_1 objects are enabled, This parameter defines the group reporting mask for the last mapped point (See Table 38)

Table 47 [C_RC_NA_1] section parameters

***: Determined by "Size" parameter**

6.2.15 [C_SE_NA_1] Section parameter description

Section Item (Key)	Range/Type	Description

Section Item (Key)	Range/Type	Description
Size	0 to 1024	This parameter specifies the number of C_SE_NA_1 objects that will be mapped to AY registers Note: If oaddrLen parameter in [ApplicationLayer] section is 1 (1-byte IOA), this value can't be greater than 8 If 0, no C_SE_NA_1 objects will be mapped to AY registers
FirstAY	0-8192	This parameter specifies the SIXNET address of the first AY register mapped to the block
MonitorM_ME	Yes / No	This parameter specifies if M_ME_NA_1 monitor objects will be mapped
MonitorEvents	Yes / No	If monitor M_ME_NA_1 objects are mapped, this parameter specifies if they will generate events.
EventPrio	0-7	If monitor M_ME_NA_1 events are enabled, this parameter defines the reporting priority assigned to M_ME_NA events (0 = highest) Highest priority events will be reported first. Events of same IEC-60870-5-101 type assigned to the same priority are reported in chronological order **Note: If [M_ME_NA_1] section exists, same setting in [M_ME_NA_1] section will override this setting**
EventReportAs	M_ME_NA_1 or M_ME_TA_1 or M_ME_TD_1	If monitor M_ME_NA_1 events are enabled, this parameter defines the type ID used to report IEC-60870-5-101 M_ME_NA change events **Note: If [M_ME_NA_1] section exists, same setting in [M_ME_NA_1] section will override this setting**

Section Item (Key)	Range/Type	Description
DeadBand	1-32767 / Integer	Default deadband for event reporting. **Note: If [M_ME_NA_1] section exists, same setting in [M_ME_NA_1] section will override this setting**
GM0000	0x00000000 – 0xFF81FFFF	If monitor M_ME_NA_1 objects are enabled, This parameter defines the group reporting mask for the first mapped point (point number 0000) (See Table 38)
…	… …	
GM<Size>*	0x00000000 – 0xFF81FFFF	If monitor M_ME_NA_1 objects are enabled, This parameter defines the group reporting mask for the last mapped point (See Table 38)

Table 48 [C_SE_NA_1] section parameters

***: Determined by "Size" parameter**

6.2.16 [C_SE_NB_1] Section parameter description

Section Item (Key)	Range/Type	Description
Size	0 to 1024	This parameter specifies the number of C_SE_NB_1 objects that will be mapped to AY registers Note: If oaddrLen parameter in [ApplicationLayer] section is 1 (1-byte IOA), this value can't be greater than 8 If 0, no C_SE_NB_1 objects will be mapped to AY registers
FirstAY	0-8192	This parameter specifies the SIXNET address of the first AY register mapped to the block
MonitorM_ME	Yes / No	This parameter specifies if M_ME_NB_1 monitor objects will be mapped

Section Item (Key)	Range/Type	Description
MonitorEvents	Yes / No	If monitor M_ME_NB_1 objects are mapped, this parameter specifies if they will generate events.
EventPrio	0-7	If monitor M_ME_NB_1 events are enabled, this parameter defines the reporting priority assigned to M_ME_NB events (0 = highest) Highest priority events will be reported first. Events of same IEC-60870-5-101 type assigned to the same priority are reported in chronological order **Note: If [M_ME_NB_1] section exists, same setting in [M_ME_NB_1] section will override this setting**
EventReportAs	M_ME_NA_1 or M_ME_TB_1 or M_ME_TE_1	If monitor M_ME_NB_1 events are enabled, this parameter defines the type ID used to report IEC-60870-5-101 M_ME_NB change events **Note: If [M_ME_NB_1] section exists, same setting in [M_ME_NB_1] section will override this setting**
DeadBand	1-32767 / Integer	Default deadband for event reporting. **Note: If [M_ME_NB_1] section exists, same setting in [M_ME_NB_1] section will override this setting**
GM0000	0x00000000 – 0xFF81FFFF	If monitor M_ME_NB_1 objects are enabled, This parameter defines the group reporting mask for the first mapped point (point number 0000) (See Table 38)
…	… …	
GM<Size>*	0x00000000 – 0xFF81FFFF	If monitor M_ME_NB_1 objects are enabled, This parameter defines the group reporting mask for the last mapped point (See Table 38)

Table 49 [C_SE_NB_1] section parameters

***: Determined by "Size" parameter**

6.2.17 [C_SE_NC_1] Section parameter description

Section Item (Key)	Range/Type	Description
`Size`	`0 to 1024`	This parameter specifies the number of C_SE_NC_1 objects that will be mapped to FY registers Note: If `oaddrLen` parameter in [`ApplicationLayer`] section is 1 (1-byte IOA), this value can't be greater than 8 If 0, no C_SE_NC_1 objects will be mapped to FY registers
`FirstFY`	0-8192	This parameter specifies the SIXNET address of the first FY register mapped to the block
`MonitorM_ME`	Yes / No	This parameter specifies if M_ME_NC_1 monitor objects will be mapped
`MonitorEvents`	Yes / No	If monitor M_ME_NC_1 objects are mapped, this parameter specifies if they will generate events.
`EventPrio`	0-7	If monitor M_ME_NC_1 events are enabled, this parameter defines the reporting priority assigned to M_ME_NC events (0 = highest) Highest priority events will be reported first. Events of same IEC-60870-5-101 type assigned to the same priority are reported in chronological order **Note: If [M_ME_NC_1] section exists, same setting in [M_ME_NC_1] section will override this setting**

Section Item (Key)	Range/Type	Description
EventReportAs	M_ME_NA_1 or M_ME_TC_1 or M_ME_TF_1	If monitor M_ME_NC_1 events are enabled, this parameter defines the type ID used to report IEC-60870-5-101 M_ME_NC change events **Note: If [M_ME_NC_1] section exists, same setting in [M_ME_NC_1] section will override this setting**
DeadBand	Floating Point Number	Default deadband for event reporting. **Note: If [M_ME_NC_1] section exists, same setting in [M_ME_NC_1] section will override this setting**
GM0000	0x00000000 – 0xFF81FFFF	If monitor M_ME_NC_1 objects are enabled, This parameter defines the group reporting mask for the first mapped point (point number 0000) (See Table 38)
…	… …	
GM<Size>*	0x00000000 – 0xFF81FFFF	If monitor M_ME_NC_1 objects are enabled, This parameter defines the group reporting mask for the last mapped point (See Table 38)

Table 50 [C_SE_NC_1] section parameters

***: Determined by "Size" parameter**

6.3 Sample Configuration File

The following is an excerpt of a working sample configuration file for a VersaTRAK mini-IPm controller model VT-MIPM-131-D. This file is included in the installable run-time package.

In addition to the Onboard I/O provided by the mini-IPm controller, the station has been configured with additional virtual modules that provide for I/O point's types not present in the Onboard I/O module.

The event-reporting scheme has been configured so that events will be reported to the controlling station whenever there are more than 5 non-reported events queue or every 10 s

Setting the selectTimeout parameter to 0 has disabled the select-Execute function. This puts the station in the "Direct Operate" mode.

```
; ********************************************************
; Sample IEC-60870-5-101/104 slave driver configuration file
; Target device: VersaTRAK mIPm VT-MIPM-131-D
; ********************************************************
; Configured modules:
; Onboard I/O (12 DI, 8 DO, 6 AI)
; M_SP_NA_1 (virtual DI) (8 DI)
; M_DP_NA_1 (virtual DI) (8 DI)
; M_ST_NA_1 (virtual AI) (8 AI)
; M_ST_NA_1_d (virtual DI) (64 DI)
; M_ME_NA_1 (virtual AI) (8 AI)
; M_ME_NB_1 (virtual AI) (8 AI)
; M_ME_NC_1 (virtual FI) (8 FI)
; M_ME_IT_1 (virtual LI) (8 LI)
; C_SC_NA_1 (virtual DO) (8 DO)
; C_DC_NA_1 (virtual DO) (8 DO)
; C_RC_NA_1 (virtual DO) (16 DO)
; M_RC_NA_1 (virtual AI) (8 AI)
; M_RC_NA_1_d (virtual DI) (64 DI)
; C_SE_NA_1 (virtual AO) (8 AO)
; C_SE_NB_1 (virtual AO) (8 AO)
; C_SE_NC_1 (virtual FO) (8 FO)
;
; I/O Mappings configuration defined in this file:
;
; IEC-60870-5-101/104 Object address length = 2 octets
;      Qty         IEC OBJECTS         SIXNET REGISTERS
;       8  M_SP_NA_1[0x0000-0x0007]<-> X[00012-00019]
;       4  M_DP_NA_1[0x0400-0x0403]<-> X[00020-00027]
;       8  M_ST_NA_1[0x0800-0x0807]<->AX[00022-00029]**
;       8  M_ST_NA_1[0x0800-0x0807]<-> X[00028-00035]**
;       8  M_ST_NA_1[0x0800-0x0807]<-> X[00028-00091]***
;       8  M_ME_NA_1[0x0C00-0x0C07]<->AX[00006-00013]
;       8  M_ME_NB_1[0x2000-0x2007]<->AX[00014-00021]
```

```
;       8  M_ME_NC_1[0x3400-0x3407]<->FX[00000-00007]
;       8  M_IT_NA_1[0x4800-0x4807]<->LX[00000-00007]
;       8  C_SC_NA_1[0x4C00-0x4C07]<-> Y[00008-00015]
;       8  M_SP_NA_1[0x5000-0x5007]<-> Y[00008-00015]*
;       4  C_DC_NA_1[0x5400-0x5403]<-> Y[00016-00023]
;       4  M_DP_NA_1[0x5800-0x5803]<-> Y[00016-00023]*
;       8  C_RC_NA_1[0x5C00-0x5C07]<-> Y[00024-00039]
;       8  M_ST_NA_1[0x6000-0x6007]<->AX[00030-00037]*, **
;       8  M_ST_NA_1[0x6000-0x6007]<-> X[00092-00099]*, **
;       8  M_ST_NA_1[0x6000-0x6007]<-> X[00092-00155]*, ***
;       8  C_SE_NA_1[0x6400-0x6407]<->AY[00000-00007]
;       8  M_ME_NA_1[0x6800-0x6807]<->AY[00000-00007]*
;       8  C_SE_NB_1[0x6C00-0x6C07]<->AY[00008-00015]
;       8  M_ME_NB_1[0x7000-0x7007]<->AY[00008-00015]*
;       8  C_SE_NC_1[0x7400-0x7407]<->FY[00000-00007]
;       8  M_ME_NC_1[0x7800-0x7807]<->FY[00000-00007]*
;
;   * Monitored Controls
;  ** M_ST_NA_1 in Analog interface mode
; *** M_ST_NA_1 in discrete interface mode
;
; Event reporting configuration:
;
; M_SP_NA_1 events reported as M_SP_TB_1 (Single-point information with time tag CP56Time2a)
; M_DP_NA_1 events reported as M_DP_TB_1 (Double-point information with time tag CP56Time2a)
; M_ST_NA_1 events reported as M_ST_TB_1 (Step position information with time tag CP56Time2a)
; M_ME_NA_1 events reported as M_ME_TD_1 (Measured value, normalized value w/time tag CP56Time2A)
; M_ME_NB_1 events reported as M_ME_TE_1 (Measured value, scaled value with time tag CP56Time2A)
; M_ME_NC_1 events reported as M_ME_TF_1 (Measured value, floating point value w/time tag
CP56Time2A)
; M_IT_NA_1 events reported as M_IT_TB_1 (Integrated totals with time tag CP56Time2A)
;
; M_SP_NA events will be reported first (priority = 0),
; M_DP_NA events next (priority = 1),
; M_ST_NA events next (priority = 2),
; M_ME_NA events next (priority = 3).
; M_ME_NB events next (priority = 4).
; M_ME_NC events next (priority = 5).
; M_IT_NA events last (priority = 6).
;
; The event queue will be checked for queued events to report every 10s. Also
; events will be reported if there are more than 5 non-reported events in queue
;
;
```

```
[General]
Project= C:\SIXNET Tools\Projects\test-iec60870-5-101.6pj
IPmStation= SixtrakIpm
Version= 200

[SxIPmStation]
EnableDataTraces = No        ; Enable debugging output
DeviceDataTraces = /nvram/sxiec60870drv.log ; Device to send debugging output (blank = stdout)
NumberTraces = 10000      ; Number of debug output lines (0 = no limit)

[DataLinkLayer]
layerType = 104              ; 101/104: The Link layer will be IEC-60870-5-101/104
;
; The following is used if layerType is 101
;
thisStationLinkAddr = 1 ; Link address of the station
LinkAddrLen = 1         ; Link address number of octets
ctrlMaxFrameLen = 249   ; Maximun length of data portion of link frames in control direction
monMaxFrameLen = 249    ; Maximun length of data portion of link frames in monitor direction
linkRetries = 1         ; Number of link transmission retries
linkTxTimeout = 2000    ; Link trasnmission communications timeout (ms)
testLinkTimer = 0       ; Link layer keepalive (send TEST_LINK frames) time (ms). 0 = disable
AorBStationIsA = No    ; This is a controlling (A) station (Yes) or a controlled (B) station (No)
BalancedMode = No       ; The driver will operate in Link Layer Balanced mode (101 mode only)
;
; The following is used if layerType is 104
;
104t1 = 15000     ; Timeout (ms) to acknowledge a sent packet before closing the connection
104t2 = 10000     ; Timeout (ms) when to send S-format message to acknowledge pending Rx messages
104t3 = 20000     ; Timeout (ms) on an idle line to send TESTFR.act messages
104k = 12         ; Number of unacknowledged messages the unit will buffer
104w = 8          ; Number of messages to receive before sending S-format ack message and no I-
format msg to send
wStartDT = Yes    ; Wait for STARTDT.con before starting to exchange data
clUnackBuff_104 = FALSE   ; Clear transport interface unack'd transmit buffer on connect

[ApplicationLayer]
timeSynchFreq = 3600000      ; Time synchronization request timeout (ms)
cotLen = 2                   ; Cause of transmission (COT) number of octets (1 or 2)
oaddrLen = 3                 ; Object address (IOA) length (1, 2 or 3)
commAddrLen = 2              ; Common address of ASDU number of octets (1 or 2)
commAddrASDU = 1    ; Common address of ASDU for this station, i.e. This station address
spontaneousReportTime = 10000   ; Time to trigger report of events (ms), 0 = no timed report
eventQueueThreshold = 5  ; Number of events in event queue to trigger event report (0 = no check)
masterEventEnable = Yes  ; Enable/Disable event collection and reporting
```

```
eventQueueLength = 512 ; Main event queue maximum length
selectTimeout = 2000    ; Select-execute timeout for all select-execute outputs (ms).
                        ; 0 will disable function (direct command)
shortPulseDuration = 500 ; Duration in ms for Short Pulse controls
longPulseDuration = 2000 ; Duration in ms for Long Pulse controls
returnInfControlComplete = Yes ; Send M_SP/M_DP/M_SE/M_ST data after execute commands
(RETURN_INF)
C_SEActterm = No          ; Send ACTTERM after processing C_SE commands
cyclicTimer = 300000      ; Cyclic poll timer (ms)
backgroundTimer = 900000  ; Background poll timer (ms) (0 = Disable)
allowedCtrlTime = 10000 ; Time window (ms) to apply control commands in -104 time tagged controls
                        ; Discard commands that have been delayed in transmission for more than a
                        ; maximum (this) permissible time.
[M_SP_NA_1]
Size = 8                ; Number of IEC objects in this category
FirstX = 12             ; Starting address of SIXNET registers mapped block
EventPrio = 0           ; Event reporting priority (0 = highest)
EventReportAs = M_SP_TB_1 ; Type ID used to report events

GM0000 = 0x00000003    ; point #1 will be event reported, in group 1 and in general requests
GM0001 = 0x40000003    ; point #2 will be reported in group 1 and general requests
GM0002 = 0x00000303    ; point #3 will be event reported, in groups 1,8,9 and in general requests
GM0003 = 0x00000003    ; point #4 will be event reported, in group 1 and in general requests
GM0004 = 0x00000003    ; point #5 will be event reported, in group 1 and in general requests
GM0005 = 0x80000003    ; point #6 will be reported cyclic, in group 1 and in general requests
GM0006 = 0x80000003    ; point #7 will be reported cyclic, in group 1 and in general requests
GM0007 = 0x00010003    ; point #8 will be event reported, in group 1,16 and in general requests

[M_DP_NA_1]
Size = 4                ; Number of IEC objects in this category (2 SIXNET Xs per M_DP_NA_1)
FirstX = 20             ; Starting address of SIXNET registers mapped block
EventPrio = 1           ; Event reporting priority (0 = highest)
EventReportAs = M_DP_TB_1 ; Type ID used to report events



GM0000 = 0x00000003    ; point #1 will be event reported, in group 1 and in general requests
GM0001 = 0x00000003    ; point #2 will be event reported, in group 1 and in general requests
GM0002 = 0x80000003    ; point #1 will be reported cyclic, in group 1 and in general requests
GM0003 = 0x00010003    ; point #4 will be event reported, in group 1,16 and in general requests

[M_ST_NA_1]
Size = 8                ; Number of IEC objects in this category
                       ; Starting addresses of SIXNET registers mapped block
FirstAX = 22            ; Analog part when Mixed Analog/Discrete input interfacing
FirstX = 28    ; Discrete part when Mixed Analog/Discrete input interfacing or Discrete positon
input when Discrete input mode
```

```
AnalogMode = Yes     ; Interfacing type:
; No = Discrete input interfacing, 8 discrete bits. Bits 0-6: position (two's complement binary)
; Bit 7: transient bit
; Yes = Analog input interfacing + discrete transient bit AX is position value (Integer -64 to +
63)
; X is transient bit
EventPrio = 2     ; Event reporting priority (0 = highest)
EventReportAs = M_ST_TB_1   ; Type ID used to report events
GM0000 = 0x00000003   ; point #1 will be event reported, in group 1 and in general requests
GM0001 = 0x00000003   ; point #2 will be event reported, in group 1 and in general requests
GM0002 = 0x00000003   ; point #3 will be event reported, in group 1 and in general requests
GM0003 = 0x00000003   ; point #4 will be event reported, in group 1 and in general requests
GM0004 = 0x00000003   ; point #5 will be event reported, in group 1 and in general requests
GM0005 = 0x00000003   ; point #6 will be event reported, in group 1 and in general requests
GM0006 = 0x00000003   ; point #7 will be event reported, in group 1 and in general requests
GM0007 = 0x00000003   ; point #8 will be event reported, in group 1 and in general requests



[M_ME_NA_1]
Size = 8              ; Number of IEC objects in this category
FirstAX = 6           ; Starting address of SIXNET registers mapped block
EventPrio = 3         ; Event reporting priority (0 = highest)
EventReportAs = M_ME_TD_1 ; Type ID used to report events
DeadBand = 5          ; Default deadband for event reporting
GM0000 = 0x80000003   ; point #1 will be reported cyclic, in group 1 and in general requests
GM0001 = 0x80000003   ; point #2 will be reported cyclic, in group 1 and in general requests
GM0002 = 0x80000003   ; point #3 will be reported cyclic, in group 1 and in general requests
GM0003 = 0x00000005   ; point #4 will be event reported, in group 2 and in general requests
GM0004 = 0x00000009   ; point #5 will be event reported, in group 3 and in general requests
GM0005 = 0x00000011   ; point #6 will be event reported, in group 4 and in general requests
GM0006 = 0x00000021   ; point #7 will be event reported, in group 5 and in general requests
GM0007 = 0x00010003   ; point #8 will be event reported, in groups 1,16 and in general requests

[M_ME_NB_1]

Size = 8              ; Number of IEC objects in this category
FirstAX = 14          ; Starting address of SIXNET registers mapped block
EventPrio = 4         ; Event reporting priority (0 = highest)
EventReportAs = M_ME_TE_1 ; Type ID used to report events
DeadBand = 2              ; Default deadband for event reporting
GM0000 = 0x80000003     ; point #1 will be reported cyclic, in group 1 and in general requests
GM0001 = 0x80000003     ; point #2 will be reported cyclic, in group 1 and in general requests
GM0002 = 0x80000003     ; point #3 will be reported cyclic, in group 1 and in general requests
GM0003 = 0x00000005     ; point #4 will be event reported, in group 2 and in general requests
GM0004 = 0x00000009     ; point #5 will be event reported, in group 3 and in general requests
```

```
GM0005 = 0x00000011     ; point #6 will be event reported, in group 4 and in general requests
GM0006 = 0x00000021     ; point #7 will be event reported, in group 5 and in general requests
GM0007 = 0x00010003     ; point #8 will be event reported, in groups 1,16 and in general requests

[M_ME_NC_1]
Size = 8                ; Number of IEC objects in this category
FirstFX = 0             ; Starting address of SIXNET registers mapped block
EventPrio = 5           ; Event reporting priority (0 = highest)
EventReportAs = M_ME_TF_1 ; Type ID used to report events
DeadBand = 0.5                    ; Deaband for event reporting
GM0000 = 0x80000003     ; point #1 will be reported cyclic, in group 1 and general requests
GM0001 = 0x80000003     ; point #2 will be reported cyclic, in group 1 and general requests
GM0002 = 0x80000003     ; point #3 will be reported cyclic, in group 1 and general requests
GM0003 = 0x00000005     ; point #4 will be event reported, in group 2 and general requests
GM0004 = 0x00000009     ; point #5 will be event reported, in group 3 and general requests
GM0005 = 0x00000011     ; point #6 will be event reported, in group 4 and general requests
GM0006 = 0x00000021     ; point #7 will be event reported, in group 5 and general requests
GM0007 = 0x00010003     ; point #8 will be event reported, in groups 1,16 and in general requests

[M_IT_NA_1]
Size = 8                ; Number of IEC objects in this category
FirstLX = 0             ; Starting address of SIXNET registers mapped block
EventPrio = 6             ; Event reporting priority (0 = highest)
EventReportAs = M_IT_TB_1 ; Type ID used to report events
Mode = C                  ; Counter mode of operation
FreezeTimer = 5000        ; Internal freeze period for modes A or B (ms)
EvtFrozenChgOnly = Yes    ; Only send frozen counter events when frozen counters change (modes A
and D)
GM0000 = 0x00060000        ; point #1 will be in counter group 1 and in general counter requests
GM0001 = 0x000A0000        ; point #2 will be in counter group 2 and in general counter requests
GM0002 = 0x00120000       ; point #3 will be in counter group 3 and in general counter requests
GM0003 = 0x00220000       ; point #4 will be in counter group 4 and in general counter requests
GM0004 = 0x00020000       ; point #5 will be reported in general counter requests
GM0005 = 0x00020000       ; point #6 will be reported in general counter requests
GM0006 = 0x00020000       ; point #7 will be reported in general counter requests
GM0007 = 0x00020000       ; point #8 will be reported in general counter requests

[C_SC_NA_1]
Size = 8                 ; Number of IEC objects in this category
FirstY = 8                ; Starting address of SIXNET registers mapped block
MonitorM_SP = Yes         ; Enable monitoring of outputs
MonitorEvents = Yes       ; Enable event generation on monitoring objects
EventPrio = 0              ; Event reporting priority (0 = highest)
EventReportAs = M_SP_TB_1 ; Type ID used to report events
GM0000 = 0x00000081      ; point #1 will be event reported, in group 7 and in general requests
```

```
GM0001 = 0x00000081      ; point #2 will be event reported, in group 7 and in general requests
GM0002 = 0x00000081      ; point #3 will be event reported, in group 7 and in general requests
GM0003 = 0x00000081      ; point #4 will be event reported, in group 7 and in general requests
GM0004 = 0x80000081      ; point #5 will be reported cyclic, in group 7 and in general requests
GM0005 = 0x80000081      ; point #6 will be reported cyclic, in group 7 and in general requests
GM0006 = 0x80000081      ; point #7 will be reported cyclic, in group 7 and in general requests
GM0007 = 0x80010081      ; point #8 will be reported cyclic, in groups 16,7 and in general
requests


[C_DC_NA_1]
Size = 4                 ; Number of IEC objects in this category
FirstY = 16              ; Starting address of SIXNET registers mapped block
MonitorM_DP = Yes        ; Enable monitoring of outputs
MonitorEvents = Yes      ; Enable event generation on monitoring objects
EventPrio = 1            ; Event reporting priority (0 = highest)
EventReportAs = M_DP_TB_1 ; Type ID used to report events
GM0000 = 0x00000401      ; point #1 will be event reported, in group 10 and in general requests
GM0001 = 0x80000401      ; point #2 will be reported cyclic, in group 10 and in general requests
GM0002 = 0x00000401      ; point #3 will be event reported, in group 10 and in general requests
GM0003 = 0x80010401      ; point #4 will be reported cyclic, in groups 16,10 and in general
requests


[C_RC_NA_1]
Size = 8                 ; Number of IEC objects in this category
FirstY = 24              ; Starting address of SIXNET registers mapped block (Discrete outs)


MonitorM_ST = Yes        ; Enable monitoring of outputs via dedicated M_ST points
FirstAX = 30             ; Monitoring Analog part when Mixed Analog/Discrete input interfacing
FirstX = 92             ; Monitoring Discrete part when Mixed Analog/Discrete input interfacing
or Discrete positon input when Discrete input mode
AnalogMode = No         ; Monitoring Interfacing type (if no read/only M_ST_NA_1 objects
defined):
; No = Discrete input interfacing, 8 discrete bits. Bits 0-6: position (two's complement binary)
; Bit 7: transient bit
; Yes = Analog input interfacing + discrete transient bit AX is position value (Integer -64 to +
63)
; X is transient bit
MonitorEvents = Yes      ; Enable event generation on monitoring objects
EventPrio = 2            ; Event reporting priority (0 = highest) (if no read/only M_ST_NA_1
objects defined)
EventReportAs = M_ST_TB_1 ; Type ID used to report events (reported back as M_ST points) (if no
read/only M_ST_NA_1 objects defined)
GM0000 = 0x00000801      ; point #1 will be event reported, in group 11 and in general requests
GM0001 = 0x80000801      ; point #2 will be reported cyclic, in group 11 and in general requests
GM0002 = 0x00000801      ; point #3 will be event reported, in group 11 and in general requests
GM0003 = 0x80000801      ; point #4 will be reported cyclic, in group 11 and in general requests
GM0004 = 0x00000801      ; point #5 will be event reported, in group 11 and in general requests
GM0005 = 0x80000801      ; point #6 will be reported cyclic, in group 11 and in general requests
```

```
GM0006 = 0x00000801      ; point #7 will be event reported, in group 11 and in general requests
GM0007 = 0x80010801      ; point #8 will be reported cyclic, in group 16,11 and in general
requests

[C_SE_NA_1]
Size = 8                ; Number of IEC objects in this category
FirstAY = 0             ; Starting address of SIXNET registers mapped block
MonitorM_ME = Yes        ; Enable monitoring of outputs
MonitorEvents = Yes      ; Enable event generation on monitoring objects
EventPrio = 3            ; Event reporting priority (0 = highest)
EventReportAs = M_ME_TD_1 ; Type ID used to report events
DeadBand = 5              ; Default deadband for event reporting
GM0000 = 0x00001001       ; point #1 will be event reported, in group 12 and in general requests
GM0001 = 0x80001001       ; point #2 will be reported cyclic, in group 12 and in general requests
GM0002 = 0x00001001       ; point #3 will be event reported, in group 12 and in general requests
GM0003 = 0x80001001       ; point #4 will be reported cyclic, in group 12 and in general requests
GM0004 = 0x00001001       ; point #5 will be event reported, in group 12 and in general requests
GM0005 = 0x80001001       ; point #6 will be reported cyclic, in group 12 and in general requests
GM0006 = 0x00001001       ; point #7 will be event reported, in group 12 and in general requests
GM0007 = 0x80011001       ; point #8 will be reported cyclic, in group 16,12 and in general
requests

[C_SE_NB_1]
Size = 8                  ; Number of IEC objects in this category
FirstAY = 8               ; Starting address of SIXNET registers mapped block
MonitorM_ME = Yes         ; Enable monitoring of outputs
MonitorEvents = Yes       ; Enable event generation on monitoring objects
EventPrio = 4             ; Event reporting priority (0 = highest)
EventReportAs = M_ME_TE_1 ; Type ID used to report events
DeadBand = 10             ; Default deadband for event reporting
GM0000 = 0x00002001       ; point #1 will be event reported, in group 13 and in general requests
GM0001 = 0x80002001       ; point #2 will be reported cyclic, in group 13 and in general requests
GM0002 = 0x00002001       ; point #3 will be event reported, in group 13 and in general requests
GM0003 = 0x80002001       ; point #4 will be reported cyclic, in group 13 and in general requests
GM0004 = 0x00002001       ; point #5 will be event reported, in group 13 and in general requests
GM0005 = 0x80002001       ; point #6 will be reported cyclic, in group 13 and in general requests
GM0006 = 0x00002001       ; point #7 will be event reported, in group 13 and in general requests
GM0007 = 0x80012001       ; point #8 will be reported cyclic, in group 16,13 and in general
requests

[C_SE_NC_1]
Size = 8                  ; Number of IEC objects in this category
FirstFY = 0               ; Starting address of SIXNET registers mapped block
MonitorM_ME = Yes         ; Enable monitoring of outputs
MonitorEvents = Yes       ; Enable event generation on monitoring objects
EventPrio = 5             ; Event reporting priority (0 = highest)
```

```
EventReportAs = M_ME_TF_1 ; Type ID used to report events
DeadBand = 10             ; Default deadband for event reporting
GM0000 = 0x00004001       ; point #1 will be event reported, in group 14 and in general requests
GM0001 = 0x80004001       ; point #2 will be reported cyclic, in group 14 and in general requests
GM0002 = 0x00004001       ; point #3 will be event reported, in group 14 and in general requests
GM0003 = 0x80004001       ; point #4 will be reported cyclic, in group 14 and in general requests
GM0004 = 0x00004001       ; point #5 will be event reported, in group 14 and in general requests
GM0005 = 0x80004001       ; point #6 will be reported cyclic, in group 14 and in general requests
GM0006 = 0x00004001       ; point #7 will be event reported, in group 14 and in general requests
GM0007 = 0x80014001       ; point #8 will be reported cyclic, in group 16,14 and in general
requests
```

6.4 SIXNET IPm IEC-60870-5-101 Protocol interoperability Document

Note: The content of this section has been extracted from the original IEC 60870-5-101 document, section 8, and has been filled-up to reflect the interoperability data of the SIXNET IPm IEC-60870-5-101 Slave Protocol Driver. The paragraph-numbering scheme of the original document source has been maintained to ease the comparison of this specification against other systems specifications for interoperability issues assessment and resolution.

SIXNET-IEC60870-5-101-Interoperability-\

6.5 SIXNET IPm IEC-60870-5-104 Protocol interoperability Document

Note: The content of this section has been extracted from the original IEC 60870-5-104 document, section 9, and has been filled-up to reflect the interoperability data of the SIXNET IPm IEC-60870-5-104 Slave Protocol Driver. The paragraph-numbering scheme of the original document source has been maintained to ease the comparison of this specification against other systems specifications for interoperability issues assessment and resolution.

"SIXNET-IEC60870-5-104-Interoperability-